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ABSTRACT

The tables, graphs, articles, and other sources of information in this document are designed to provide teachers with additional resources to supplement the unit "Motions and Collisions." The information is coordinated with the unit objectives specified in "Science 100, 101," the currently (1982) approved provincial guide for grade 10 science in Manitoba schools. General content areas include: (1) first and second collisions; (2) safety features related to seat belts; (3) injuries related to belted and unbelted passengers; and (4) pros and cons of seatbelt laws. No particular instructional strategy is fostered and, in some instances, teachers may wish to extend the unit beyond the design in the curriculum guide. For example, the paper which relates seat belt legislation to safety ("The Effects of Seat Belt Legislation: The Saskatchewan Experience") could be used to examine the uncertainty of relating data in a one-to-one relationship between two variables, such as safety and the use of seat belts, or could be used as an additional source of information for students. (Author/JN)

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MOTION AND COLLISIONS

A Supplement

to the

Science 100, 10 Curriculum Guide

Manitoba Department of Education

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INTRODUCTION

The tables, graphs, articles, and other sources of information in this document will provide teachers with additional resources to supplement the unit "Motion and Collisions." The information is co-ordinated with the unit objectives specified in the Science 100, 101 guide; however, no particular teaching approach is implied. In some instances, teachers may wish to extend the unit beyond the design in the curriculum guide.

For example, the paper which relates seat belt legislation to safety (The Effects of Seat Belt Legislation: The Saskatchewan Experience) could be used to examine the uncertainty of relating data in a one-to-one relationship between two variables, such as safety and the use of seat belts, or could be used as an additional source of information for students.

FIRST AND SECOND COLLISIONS

OBJECTIVE: Describe when the first and second collisions in auto accidents occur and describe the results of each collision.

WHAT HAPPENS IN A COLLISION*

Lawrence Lonero, et al.

In recent years, motor vehicle collisions have been studied in an effort to reduce the severity of injuries. Ultra-slow-motion film and instruments for measuring forces have been used in these studies. As a result, we now have a good understanding of what happens to the car and to the people inside during a collision.

The Car's Collision

A standard kind of test crash involves running a remotely-controlled car straight into a solid concrete barrier. This is the simplest type of crash, and it is used as a standard or reference point for other test crashes and real accidents.

When a car strikes a solid object, it stops very abruptly. The front bumper is the first part of the car to come in contact with the barrier and it stops immediately. The front end crushes as the car comes to a complete stop.

At an impact speed of 30 miles per hour, the front of the car crushes about two feet and the car comes to a complete stop within one-tenth of a second. The crushing of the front end serves as a cushion for the rest of the car, and helps absorb the shock of the collision. As a result, the passenger compartment comes to a more gradual stop than the front of the car, and it remains undamaged by the collision.

Even in severe collisions, the passenger compartment usually remains in good shape. If a collision occurs at an extremely high speed or if the car is hit broadside, the passenger compartment can be partially crushed. Fortunately, this happens in only a small minority of all collisions. In the great majority of accidents, the front or rear end of the car sustains most of the damage. The passenger compartment usually is not damaged at all by the vehicle's collision. Instead it is damaged by the person striking it with his head or body.

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*Lawrence Lonero, et al., "What Happens in a Collision," from The Human Collision (Downsview: Ontario Ministry of Transportation and Communications, 1976) pp. 1-5. Reprinted with permission.

0.000 seconds - car hits barrier

On impact, the car begins to crush and to slow down. The person inside the car has nothing to slow him down so he continues to move forward inside the car at 30 mph.

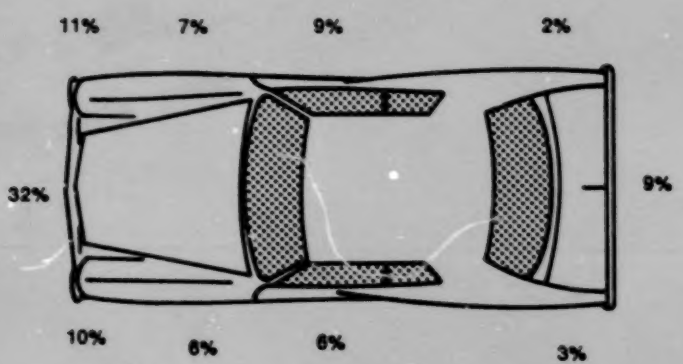
0.050 seconds - car crushes

The car slows down as the crushing of the front end absorbs some of the force of the collision. The person inside is still moving forward at 30 mph.

0.100 seconds - car stops

0.120 seconds - person hits car interior

One-fiftieth of a second after the car has stopped, the person slams into the dashboard and windshield. This is the human collision. In the car's collision it takes 1/10 of a second to stop; in the human collision it takes only 1/100 of a second.



Percentages of Primary Impact in Urban Accidents

There are fewer side impacts in highway collisions (G. M. Mackay and C. P. de Fonseka, 1967)

The Human Collision

It has become clear that there are really two kinds of collisions within a single accident. The first is the car's accident in which the car hits something, buckles and bends, and then comes to a stop. The second and more important collision is the "human collision" which happens when a person hits some part of the car. It is the human collision that causes injury.

In the 30-mile per hour barrier crash, the car is crushed a couple of feet and comes to a stop about one-tenth of a second after hitting the barrier. Slow-motion film would show that the people keep moving inside the passenger compartment at 30 miles per hour. They continue moving inside the car during the one-tenth of a second that the car takes to stop. The people are still moving forward at their original speed when they slam into the steering wheel, windshield or some other part of the car. This is the human collision.

It's The Human Collision That Hurts

It is not easy to appreciate just how severe the human collision can be. To help understand what happens, imagine someone walking briskly head-first into a steel post. This would be about a 3 or 4-mile per hour human collision. The person would probably survive without serious injury. Then imagine him running full speed into the steel post. This would be about a 15-mile per hour collision. His injuries would be severe and he might not survive. Now imagine his head striking the post at 30 miles per hour. The force would be four times greater than at 15 miles per hour and the person would not survive. In a 30-mile per hour barrier crash, an occupant strikes the interior of the car with a force of several thousand pounds, causing serious injury to himself.

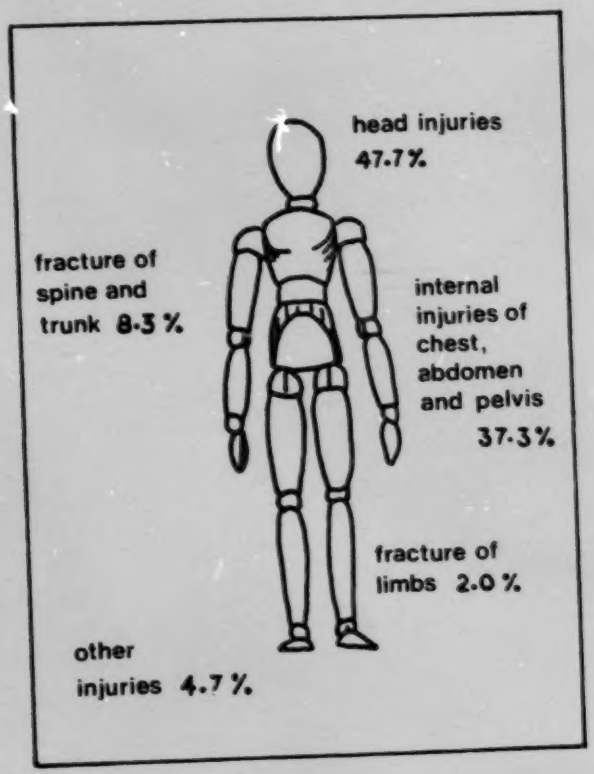
During a collision a person can strike the windshield, the windshield frame or a door post. All of these are hard and unyielding. When a person hits something hard he must come to a stop over a very short distance, one to two inches. Because the hard surface will give way very little, his body must absorb most of the force of the impact.

Head and chest injuries are the most frequent cause of death in collisions. In Ontario about half of fatal accident victims die of head injuries. Severe injuries to the head and chest can result even in minor accidents. Chest injuries from the steering assembly are common in car accidents. Facial disfigurement often results from striking the windshield.

When an occupant strikes a hard edge, a knob or a lever in the car, all of the force of the impact is concentrated on only a small part of the body's surface. For example, gearshift levers have been known to penetrate the skull and cause death. Severe injury from hard or sharp objects can result even in a relatively minor crash.

If a person hits the steering wheel or a padded portion of the interior, some of the force is absorbed by the car. Except in very low-speed collisions, this will not be enough to protect the occupants from injuries. Padded dashboards and collapsible steering columns provide only a few inches of cushioning. If an occupant's head hits a well-padded dashboard at more than 30 miles per hour, serious injury will result.

Some people believe that they can protect themselves in a crash by holding onto the steering wheel, or bracing themselves with their arms or legs. Collisions usually happen too fast to permit this. Even if there is time to brace yourself, the forces involved in most collisions are too great to withstand, even at moderate speeds.



Percentages of Fatal Injuries in Vehicle Collisions
Injuries to the head are the most frequent cause of death in vehicle collisions.

Person-To-Person

In a collision, passengers tend to move towards the point of impact, not away from it as might be expected. The tendency of everyone in the car to move in the same direction during a collision sometimes gives the term "human collision" special meaning.

In a frontal collision, people in the front seat can receive serious neck and spinal injuries from being struck by rear-seat passengers. Vehicle occupants can bump heads with fatal force. In a side collision a person can crash into the passenger next to him and force him out the window or door. During a collision people become high-speed projectiles, so it is not surprising that person-to-person contact is a common source of injury.

People often carry young children on their laps while riding in a car. This can lead to another form of human collision. Accident studies have shown that mothers can crush their children against the dashboard during a crash. Even in a relatively minor accident or panic stop, a child can be pulled away with surprising force and hit the dashboard or floor.

TEST FOR SAFETY (THE EGG DROP ACTIVITY)

Have students design devices which will prevent an egg from breaking when it is dropped from a fixed height. Designs could include padded packages, air-drag structures, shock-absorbing mechanisms, gliding apparatus, or collapsing structures. Students should determine the restrictions and measurement methods in the test design.

For further information see Alan McCormack, "Egg Drop: An Invention Workshop," in Science Activities (1973), pp. 20-22.

SAFETY FEATURES: SEAT BELTS

OBJECTIVE: Describe the safety features of a padded dashboard, a seat belt system and an air bag system.

TEST FOR SAFETY: SEAT BELTS, APPENDIX 1*

Ministry of Transport

Injuries due to seat belts have been documented but generally are slight in comparison with the injuries that would have been sustained had the occupant not been wearing seat belts. In high speed accidents one cannot expect to emerge entirely unscathed; seat belts generally reduce the severity, a fatal injury becomes only serious, a sore shoulder is traded for a skull fracture. In some cases, however, seat belts have caused an injury, generally in the abdominal area. These injuries have almost always been found to be due to incorrect adjustment of the lap belt allowing it to slip off the pelvis and onto the abdomen.

Another persistent myth concerning seat belts is that they can trap the occupant in a burning or submerged car. The statistics show no basis for this fear. Less than one percent of all serious accidents are followed by fire or submersion.[7] Furthermore, the risk of entrapment and subsequent incineration inside a burning car is directly related to the degree of injury suffered by the occupants. A belted occupant is far more likely to remain conscious and thus able to effect a speedy escape from the vehicle. The chance of injury and the related risk of entrapment through incapacity is, therefore, far lower if a seat belt is worn. A similar argument exists in the case of submersion.

The current major alternative to seat belts is airbags. Their chief advantage is that they require no action on the part of the vehicle occupant. A second advantage, especially with respect to the North American driving environment, is the airbag's ability, demonstrated under test conditions, to afford better protection than the belt in high speed (over 60 mph) frontal collisions.[8,11] However, the upper limit of survival of lap/shoulder belt wearers is yet undetermined in real crash situations but is thought to be higher than that postulated on the basis of tests.

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*Test For Safety: Seat Belts, Appendix I (Countermeasures Development, Road and Motor Vehicle Traffic Safety, Ministry of Transport, Ottawa, 1974). Reprinted with permission.

Airbags, however, have a number of significant disadvantages that render them a distinct second choice to seat belts. It has been estimated that airbags could be as effective as lap/shoulder belts (if worn) only if they were combined with the wearing of lap belts.[9,12] This is due to airbags' relative ineffectiveness in non-frontal collisions and in collisions involving ejection of the occupant. In a study of 105 severe and fatal accidents in the U. K. it was concluded that belts were superior to airbags because they provide protection in a greater number of collision types.[10,11] Therefore, in order for the airbag to offer the occupant the same protection as the lap/shoulder belt, it must be used in combination with a lap belt. The lap belt provides the important ejection inhibiting potential that airbags lack. Thus the problem of non-wearing of the lap belt remains negating the airbag's major advantage of no required occupant action.

Further, the cost of an airbag equipped car is almost $150[12] more than a belt equipped car. As airbags have never been in use on any large scale, estimates of benefits are just that; the most optimistic estimate is that airbags will derive benefits only slightly greater than costs and equal to those for about 75% belt utilization. The pessimistic estimate makes benefits far less than costs and equivalent to 33% belt utilization.[11,13]

Finally, and perhaps most importantly, while seat belts offer an immediate solution because they are already available on at least 85% of all cars, airbags would become available only gradually, ten years being necessary before the entire vehicle population were equipped.

REFERENCES:

7. Houts, Marshall; Seat Belt Injuries, Journal of Trauma, February 1970.

8. Carter, Robert L.; D.O.T. Crash Survivability Program. Proceedings of First International Conference on Passive Restraints. May 11-12, 1970, Milford, Michigan.

9. Scheel, J. W.; Benefit Study of Eight Vehicle Occupant Restraint Configurations. General Motors Environmental Activities, June 1973.

10. Mackay, G. Murray; An Assessment of Active and Passive Restraints in Serious Injury European Car Occupant Collisions. Symposium on Linear Acceleration (Impact Type), AGARD, 1971.

11. Cumulative Regulatory Effects on the Cost of Automotive Transportation (RECAT). U. S. Office of Science and Technology, February 1972.

12. Statement of Fred Secrest, Executive Vice-President, Ford Motor Company. Hearings before the Committee on Commerce, United States Senate, Ninety-third Congress, First Session Air Bag Development and Technology, August 1, 1973. Serial No. 93-43.

13. Perini, Victor J.; Vehicle Occupant Restraints. Highway Users Foundation for Safety and Mobility, 1776 Massachusetts Ave., N.W., Washington, D. C. 20036, November 1973.

OBJECTIVE: Describe when seat belts work best to reduce passenger injuries in collisions.

THE CASE FOR SEAT BELTS: APPENDIX 2*

U. S. Department of Transportation

B. Ways in which seat belts reduce injuries.

1. Belts prevent ejection.

The Cornell University Medical College made a study of 3,261 automobiles involved in accidents, each one of which contained at least one injured person. The study disclosed that 13.6 percent of all occupants were completely ejected from the automobile. There were 9.6 percent fewer fatalities among those not ejected than among those ejected.

(Boris Tourin, "Ejection and Automobile Fatalities," Public Health Reports, May, 1958, pp. 381-383.)

In a study of 177 crash fatalities, Huelke and Gikas found that 27 percent of the fatally injured occupants had been ejected. They postulated that 80 percent of those ejected could have survived with the use of lap belts.

(D. F. Huelke and P. W. Gikas, "Causes of Death in Automobile Accidents," Journal of the American Medical Association, 1968, pp. 1100-1107.)

"Partial body ejection is not prevented by use of a lap belt alone. Numerous cases are documented in which dangerous and fatal injuries occurred when the upper torso of the lap-belted occupant was ejected during a vehicle's lateral spin after impact. A shoulder restraint system prevents dangerous and fatal upper torso ejection. The following case study illustrates the advantage of an upper and lower restraint device.

Case 154 (Lap/Diagonal Belt) - A 1958 Volkswagen was struck on the left rear corner by a 1965 Ford at a speed of approximately 30-35 mph. It rolled onto its right side and skidded on its side for 60-65 ft. until

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*The Case for Seat Belts, Appendix 2 (U. S. Department of Transportation, National Highway Traffic Safety Division, Washington, 1973). Reprinted with permission.

it struck a curb where it rolled onto its top. It continued to skid about 4-5 ft. on its top until it struck a light pole and knocked the pole down. The occupant of the Volkswagen was restrained by a lap/diagonal belt. At the time of collision she first forced the seat back downward towards the rear seat. She then moved forward and to the right as the vehicle started to roll to the right. The 'three-point' lap-shoulder harness prevented contact with the forward and right side of the vehicle. When the vehicle struck the curb, the occupant struck the roof, at which point, without the lap/shoulder belt, she would have been seriously injured."

(Arnold W. Siegel, Wayne T. VanWagoner, and Alan M. Nahum, School of Medicine, University of California, Los Angeles. Case Comparisons of Restrained and Nonrestrained Occupants and Related Injury Patterns. New York: Society of Automotive Engineers, Inc., 1969, p. 2.)

"Data on 243 truck accidents were reviewed. The frequency of door openings in recent-model trucks was found similar to door opening frequency in pre-1956 passenger cars and double that of 1963 cars. The frequency of truck driver ejection was double that of recent-model auto drivers. Rate of dangerous or fatal injury among ejected truck drivers was four times as high as among those who remained in the truck, underscoring the importance of restraint systems."

(Abstract published in Highway Safety Literature of a study by Arthur Stern, A Preliminary Report on Trucks in Injury Producing Accidents. Buffalo, N.Y.: Cornell Aeronautical Laboratory, Inc., July, 1966.)

The Department of Transportation, Bureau of Motor Carrier Safety analyzed 211 of the more serious truck accidents reported to it between April 1968 and February 1969 in which the drivers or relief drivers were killed or seriously injured.

Of the 231 truck drivers involved in the study, only nine (3.9 percent) were wearing seat belts. None of these drivers was ejected or suffered a fatal injury. More than 35 percent of the drivers who were not wearing seat belts were ejected from their cabs or sleeper berths. Twenty-eight of the 44 deaths tabulated resulted from injuries following ejection.

(Department of Transportation, Bureau of Motor Carrier Safety. Crash/Injury-Ejection Study, Washington, D.C.: 1970.)

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2. Belts decrease the chance of a secondary impact with another object.

"Avoidance of secondary impact - although it is not often discussed, remaining behind the steering wheel and maintaining control of a vehicle is a frequent advantage in moderate and lower speed collisions. The driver may avoid a secondary impact or running off the roadway. Several motor coach cases, many automobile cases, and an increasing number of truck cases record that the driver was thrown from his seat during a relatively minor primary impact and thus was unable to avoid a secondary collision or running off the roadway. It appears that this is not given sufficient emphasis, especially when the advantages of restraints are described to drivers of trucks and heavy duty equipment."

(Arnold W. Siegel, Wayne T. VanWagoner, and Alan M. Nahum, School of Medicine, University of California, Los Angeles. Case Comparisons of Restrained and Nonrestrained Occupants and Related Injury Patterns. New York: Society of Automotive Engineers, Inc., 1969, p. 2.)

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3. Belts reduce the forces of the second or third collision.

"The dynamics derived from accelerometer data and high-speed motion picture film show that the forces of impact are greatly reduced by the time the occupant begins to jackknife forward and prior to striking interior surfaces within the vehicle. The expected injury patterns are reduced by this force attenuation.

It should be reemphasized that a shoulder restraint system prevents jackknifing, reduces the frequency of contact against forward surfaces, and subsequently reduces body injuries. Case 472 illustrates this force attenuation and injury reduction for a lap-belted driver.

Case 472 (Lap Belt) - A 1967 Pontiac Firebird collided first with a curb, a Volkswagen, some small brush trees, and then had its major impact with a tree at a speed of approximately 30-35 mph. This impact occurred on the left front door area of the vehicle with a static A-pillar penetration of 24 in. The driver was restrained by a lap belt. During the impact he moved forward and struck the steering wheel column (no collapse), the lower instrument panel, the A-pillar, and the door . . .

Although this was a higher speed impact into a vulnerable side location with considerable post collision deformation, the occupant's injury index was minor. This case illustrates the force-attenuating characteristics of a lap belt."

(Arnold W. Siegel, Wayne T. VanWagoner, and Alan M. Nahum, School of Medicine, University of California, Los Angeles. Case Comparisons of Restrained and Nonrestrained Occupants and Related Injury Patterns. New York: Society of Automotive Engineers, Inc., 1969, p. 3.)

C. Performance of seat belts in various types of collisions.

1. Belts protect vehicle occupants located on the side opposite from a side impact.

"Snyder and associates found by experimentation that human tolerance was lower to side impacts than front or rear impacts. In impact tests from 15-45 g, the injuries resulting from side impacts were significantly worse than injuries in either front or rear impacts.

A restrained occupant located on the opposite side from an impact will flex towards the direction of impact. If intrusion is not excessive, the lap-belted occupant will not contact any of the hard surfaces of the interior. He has the advantages of nonejection after impact. The advantages of not moving across into the impact area are important. Garrett and Braunstein found that occupants restrained on the side away from the impact did not contact the door unless excessive intrusion took place. The unrestrained occupant, however, will move across the vehicle, leading with his head and upper torso, and will contact the impacted and intruding door, A-pillar, or side rail.

Since 1967, side impact injuries have been reduced through the use of a broad armrest which allows the pelvis to contact a broad surface rather than have the narrow, older type armrest penetrate into the side of the human body. A side impact bar introduced on some 1969 vehicles will have a two-fold effect on restrained occupants. First, the door intrusion will be significantly limited, thereby reducing injuries due to intrusion. Second, when the door penetration is reduced, the lap/shoulder belt will become a more effective side-impact restraining device . . ."

(Arnold W. Siegel, Wayne T. VanWagoner, and Alan M. Nahum, School of Medicine, University of California, Los Angeles. Case Comparisons of Restrained and Nonrestrained Occupants and Related Injury Patterns. New York: Society of Automotive Engineers, Inc., 1969, pp. 14-15.)

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2. Head support needed in addition to belts to prevent whiplash in rear-end impacts.

"During an initial impact, e.g., 50-100 ms, the occupant's upper torso is partially restrained by the seat back. The occupant's head and neck, however, are not restrained unless there is a head support present. Both torso-restrained and torso-unrestrained occupants will be forced back into the seat and, if head restraint is not provided, their heads will move rearward causing possible neck hyperextension or whiplash . . .

To date there is insufficient clinic evidence available to indicate that use of a restraint system increases the so-called 'whiplash' injuries . . .

It is anticipated then, that the increasing use of head restraints, if adjusted to the proper head height, will decrease neck hyperextension during rear-end impact."

(Arnoid W. Siegel, Wayne T. VanWagoner, and Alan M. Nahum, School of Medicine, University of Californ[illegible], Los Angeles. Case Comparisons of Restrained and Nonrestrained Occupants and Related Injury Patterns. New York: Society of Automotive Engineers, Inc., 1969, pp. 16-17.)

D. Need for seat belts in rear as well as front seat positions.

Results of an analysis of the injuries sustained by 837 drivers or front-seat passengers who were involved in accidents and who were wearing seat belts at the time of the accident showed a 51 percent over-all reduction in injuries resulting from the wearing of belts. The reduction in serious injuries was greater than the reduction in slight injuries.

(R. D. Lister, M. D., and Barbara M. Milsom, "Car Seat Belts: An Analysis of the Injuries Sustained by Car Occupants," The Practitioner, 1963, p. 340.)

"Much attention has been focused in recent years, as a result of automobile crash investigation studies, on the injury producing potential of the front-seat environment as well as on the ejection of front-seat occupants. As a result of the study in which the authors are participating, concerning on-the-scene investigation of fatal automobile accidents in Washtenaw County, it has become apparent that rear-seat occupants are not immune to serious injury or death. The common misconception also exists that the rear-seat occupant in a two-door car is immune to ejection . . .

During the investigation of 137 automobile accidents involving 174 fatalities, it was found that 23 of the victims were occupants of the rear seat at the time of the collision. Six of these rear-seat occupants died as a result of injuries sustained when they were ejected from the vehicle. Seventeen victims sustained fatal injuries in the secondary collision within the vehicle.

. . . approximately half [of these 23 fatalities] could have survived if a seat belt would have been worn."

(Paul W. Gikas and Donald F. Huelke, "Pathogenesis of Fatal Injuries to Rear Seat Occupants of Automobiles." Reprinted from Proceedings of the 9th Stapp Car Crash Conference, University of Minnesota, 1966.)

"A study was made of 54 collisions resulting in injuries to rear-seat occupants unrestrained by seat belts. It was determined that children (who represent a disproportionate percentage of rear-seat occupants) tend to become airborne and to incur severe injuries against the windshield, mirror, dashboard, and heater. Adults tend to injure the face and head against the front seat and to sustain typical leg fractures from trapping their feet under the front seat. The occupants seated at the outside edges of the rear seat sustained dangerous injuries from metal ash trays and window crank handles out of proportion to the severity of the collision. All unrestrained rear-seat occupants add to the injuries of front-seat occupants by hurtling into them."

(A. Nahum, A. W. Siegel, and P. V. Hight, Vehicle Trauma Research Group, Department of Surgery, UCLA School of Medicine, 1967. Abstract published in Traffic Safety, March 1968, p. 29.)

OBJECTIVE: Describe when seat belts work best to reduce passenger injuries in collisions.

THE CASE FOR WEARING YOUR SEAT BELT: IF YOU DON'T*

Carl Shiels and Cathie Fornssler

Since April, 1972, the Transportation Centre at the University of Saskatchewan has been investigating how people are injured or killed in car accidents. The Centre (formerly the Vehicle Accident Study Team) has studied 300 car accidents, from single-car rollovers to multiple-car pileups.

Much of the injury and death we have witnessed in the last two and a half years need not have happened. With the stronger, more crashworthy cars now being produced and with regular use of seatbelts, people on the road today could survive even the worst high-speed collisions.

This has been said before. Yet even now, fewer than 20 per cent of drivers and passengers wear seatbelts regularly. Do people adopt the "ostrich" approach and refuse to consider the possibility of an accident, believing death or injury to be inevitable? Our research has shown that the use of seatbelts could prevent many serious and fatal injuries. Do people believe that, at the time of an accident, they can take action to avoid injury? This is almost impossible. In the milli-seconds of an accident impact, there is no time to throw your hands up to protect your face, to turn your body to shield a child, even to grab onto something to prevent being thrown forward into the windshield or being thrown out the door. Precautions must be taken before the accident occurs--and those precautions can almost certainly save your life.

Four Basic Reasons

We have found four reasons why people are injured or killed in car accidents. Though the explanations are rather technical, these four mechanisms of injury are basically simple and the first three are also simple to protect yourself against.

The uncontrollable factor in a car accident is the deceleration of a car, but previous research has shown that the human body can withstand enormous impact particularly for very short periods of time. The shock of sudden deceleration as occurs when the two cars collide at high

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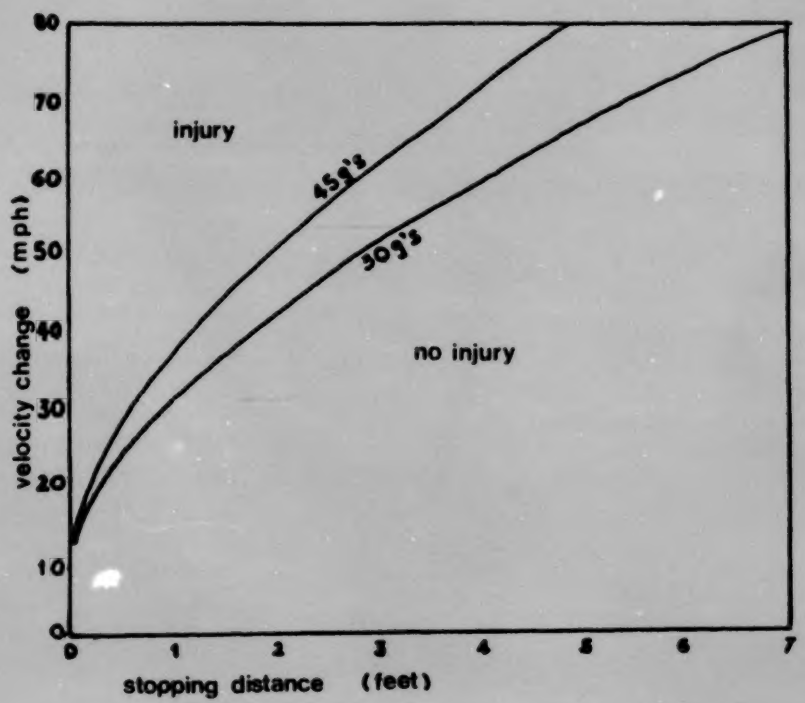
*Carl Shiels and Cathie Fornssler, "The Case for Wearing Your Seat Belt: If You Don't" (The Canadian Consumer, 5, February, 1975), pp. 27-29. Reprinted with permission.

speed is no greater than the levels survived by volunteers in rocket sleds or by parachutists whose chutes failed to open. The deceleration level at which injuries begin to occur is about 30 G's. (Normal gravitational force is 1 G. Under 30 G's of deceleration force, a 150-pound man would weigh 4,500 pounds, but this is only where injuries start to occur.) In an accident, the G force rises as the car moves faster, but even a car moving 60 miles per hour which collides with a rigid barrier will not stop in less than five feet, so the deceleration levels are always below the level of injury. Therefore, it is not the deceleration which causes death or injury in a car accident, rather it is usually at least one or more of the following.

(1) Occupant hits the car. This happens when the occupant in the car is not wearing the seatbelt and so does not stop when the car does. For example, if a full-sized American car travelling at 15 miles per hour hits a brick wall or another car of the same weight travelling at the same speed, it will stop in about 15 inches, and the front end of the car will sustain about 15 inches of crush. The deceleration rate for the car averages about 6 G's. Any occupants, whether driver or passengers, who are belted into the car will also experience about 6 G's of deceleration--well below the injury threshold. In addition, the impact force is absorbed by the pelvic girdle, an area readily able to withstand extremely high forces. But anyone not belted in will continue forward, hitting the dashboard and windshield at 15 miles per hour. Even the new padded dashboards and shatterproof windshields can only deform



a few inches, so the person will experience a deceleration rate as high as 45 G's as the stopping distance of the person is much less than that of the car. This is far above the injury threshold. As well, the impact is absorbed by the head, chest and abdomen, all of which involve vital organs. We have seen accidents where a person was killed by hitting the sunvisor hinge or the edge of a nonbreakaway rearview mirror.

(2) Occupants hit each other. In many accidents, even an unbelted person might survive if he was the only person in the car. But when passengers hit other passengers, death or serious injury often result for the person nearest the point of impact. One tragic case reported was that of a baby, being held "securely" in the grandmother's arms when the vehicle was involved in a relatively minor collision. The impact was sufficient to throw the grandmother forward, crushing the baby to death against the dash. Had the grandmother been wearing the lap and shoulder harness, she would have been able to hold the baby quite securely in this case.

Parents who feel that their children are secure when they are being held in their arms have no comprehension of the forces involved in even moderately severe accidents.

People can also be killed or injured by loose objects in the car--boxes in the back seat, etc. A two-pound thermos sitting on the rear window parcel shelf could apply an impact force of 500 pounds to the head of a front seat occupant during a 50 mile per hour collision.

(3) Occupant partially or completely ejected through side windows or doors which come open during a crash. This is most common in rollover accidents where the occupants are not wearing seatbelts. In a study of 181 people involved in rollover accidents carried out at the University of California at San Diego, half of the occupants who were partially or completely ejected from the car were killed. Neck and back injuries, sometimes resulting in paraplegia or quadraplegia, are common with partial ejections. Even with the much publicized airbag restraint system, lap belts must be worn to eliminate problems of ejection and passenger interaction.

(4) Passenger compartment penetration. Even when all occupants in a car are belted in, death or injury can result when the passenger compartment is penetrated--for example by a light pole or by another vehicle. The extent to which passenger compartment penetration affects crash survivability was dramatically demonstrated when a Volkswagen with five occupants went out of control in a snowdrift which had accumulated on a curve in a highway. Before the driver was able to regain control, the car collided with a large bus. As the bumper on the bus penetrated the side of the Volkswagen, it passed through the seating space of the right rear and center rear passengers, who were both fatally injured. However, the seating spaces of the left rear passenger and the two front seat occupants were not penetrated by the bus and as a result they sustained only minor injuries requiring no more than first aid.

Vehicle Design

Prior to United States federal safety standards in 1968, vehicle design did not attempt to deal with the problem of passenger compartment penetration. Even in minor frontal collisions, non-collapsible steering columns can be forced back far enough to cause massive internal injuries to the driver. Rollover accidents often cause complete collapse of the roof structure, particularly in hardtop and softtop convertibles. It is not uncommon to have the roof of a hardtop convertible compressed level with the top of the seats. Side impacts can also result in penetrations, particularly in hardtop convertibles, where the center door pillar is supported only at the base, frequently by a handful of rivets.

Since 1968, all vehicles for sale in Canada and the United States are required to be fitted with some form of collapsible steering column, giving the driver some margin of safety in frontal collisions. In July 1973, standards affecting side strength and rollover protection came into effect. These standards have all but eliminated hardtop convertibles as we once knew them, a loss which is not mourned by traffic safety experts.

Even small cars are now safer in so far as they must comply with the same federal safety standards as large cars. During a collision with a large vehicle, small cars experience greater velocity changes, increasing the likelihood of passenger compartment penetration. This is slightly offset by making small cars more hard-nosed, with about 3/4 inch of crush for each mile per hour in front collisions, compared to one inch of crush for each mile per hour in full-sized cars.

What does all this mean to the average automobile owner? Death or injury in car crashes are neither mysterious nor inevitable. Vehicles manufactured today are more crashworthy than they have ever been before. But the full benefit of developments in crash protection can only be fully realized if all persons wear the lap and shoulder harness restraint systems available in cars since 1968.

INJURIES: BELTED AND UNBELTED PASSENGERS

OBJECTIVE: Compare the injuries of belted and unbelted passengers in a collision, reported in graphs or tables.

THE HUMAN COLLISION*

Lawrence Lonero, et al.

Evidence From Real Accidents

Seat belts reduce forces and injuries to dummies and to humans in laboratory settings. However, this alone does not prove that they help people in real accidents. Real accidents are much more complex than controlled, laboratory collisions, but actual accidents have been studied and the findings all point to the benefit of seat belts.

Some of these studies involve on-the-scene investigations of accidents by teams of engineers and doctors. Both dead and injured persons are examined. The forces involved are estimated from damages sustained by the outside of the car. Damage to the car interior and the occupant are matched to determine the cause of injury. These accident investigation studies have all concluded that about half or more of the deaths and serious injuries would have been avoided if lap and shoulder belts had been worn.

In Metropolitan Toronto in 1970, 35 drivers and 22 passengers were killed in traffic accidents. None of them were wearing seat belts. An investigation of these fatal accidents concluded that more than half the deaths of both passengers and drivers could have been prevented if seat belts had been worn.

When large numbers of accident records were surveyed, it was again found that seat belts reduced injury and death by about half. In Sweden, a major study of 28,000 accident records was conducted in the mid-1960s. This study included all kinds of accidents, serious and minor, but only one make of car was involved. All vehicles were equipped with three-point lap and shoulder belts. The study found that belted people received about half as many injuries as unbelted people in collisions at all speeds. As expected, the greatest reductions were in head, face and chest injuries. No one wearing a seat belt was killed in any collision at speeds up to 60 miles per hour. Unbelted people were killed in collisions

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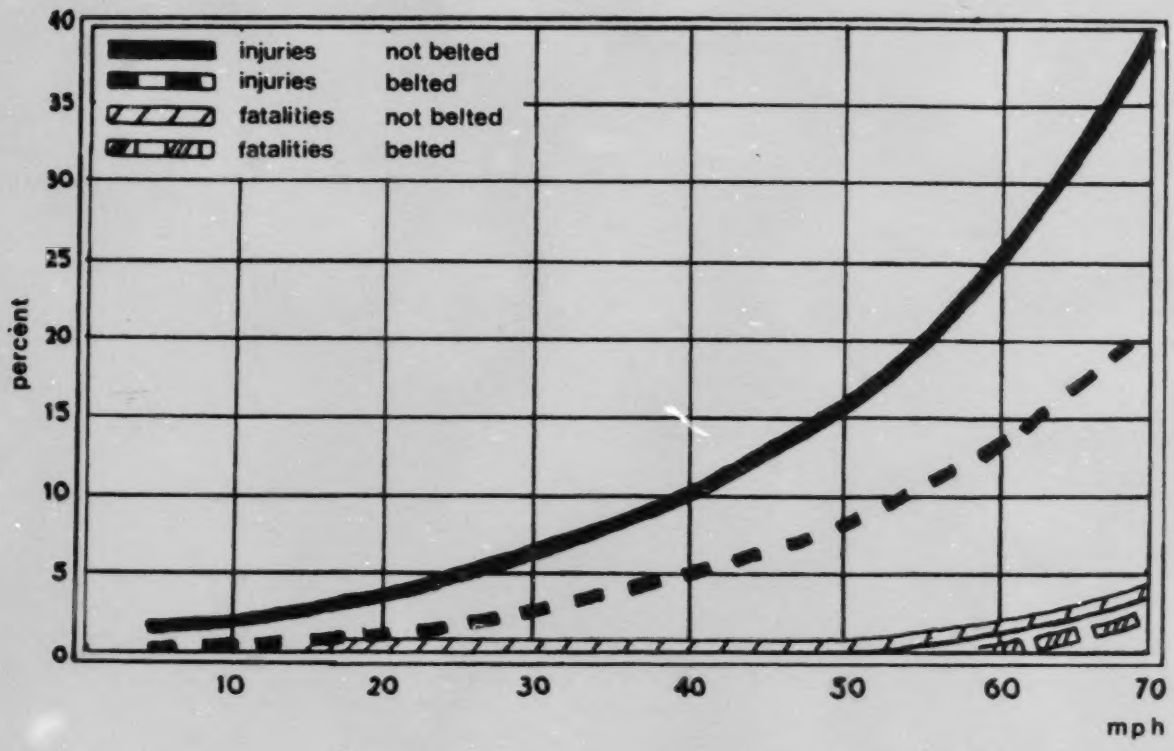
* Lawrence Lonero, et al., The Human Collision (Downsview: Ontario Ministry of Transportation and Communications, 1975), p. 11. Reprinted with permission.

at speeds less than 20 miles per hour. (Refer to the graph showing the frequency of injuries sustained by drivers.)

The Swedish study is the most widely known of its type. However, similar studies have been done in North America and all have found that belts save lives and reduce injuries in all types of real collisions. Much of the benefit from belts in real accidents is due to the dramatic effect of lap and shoulder belts in reducing the most common, serious injuries--those to the head and chest.



A Swedish study showed that belted people received about half as many injuries as unbelted people in collisions at all speeds. (N.I. Bohlin, 1967)

OBJECTIVE: Compare the injuries of belted and unbelted passengers in a collision, reported in graphs or tables.

ACCIDENTS AND INJURIES TO CAR OCCUPANTS WEARING SAFETY BELTS*

G. Grime

In the Road Research Laboratory Report No. 16 The Effectiveness of Car Safety Belts, data from about 1 200 report forms, returned by motorists who had been wearing safety belts in accidents, were analysed. The report was mainly concerned with the overall effectiveness of the various types of safety belt, although it also gave some indication of their relative merits in reducing the frequency of injury to different parts of the body. For the sample of accidents examined, it was shown that safety belts had reduced the risk of serious injury by a factor of about three, and that of any injury--either slight or serious--by about two.

Recently, an opportunity occurred to examine the accident report forms of one manufacturer of safety belts--Britax Ltd.--for the years 1965 and 1966, and it was found that the forms contained so much information, other than that relating to the overall efficiency of belts in preventing injury, that further analysis was desirable. This paper presents an analysis of some, though not all, of these data.

Reliability of Data

The data were extracted from forms enclosed with new Britax belts and completed, of their own free will, by motorists--usually drivers--who had been in cars involved in accidents. They were therefore not a random sample even of wearers of safety belts; those who returned forms were probably more conscious of road safety, and more methodical than those who did not. The proportion of motorists who wear belts also varies from place to place; fewer are worn in town than in the country; this factor would tend to reduce the proportion of accidents reported in built-up areas compared with rural accidents. On the other hand, since the information was freely given, with no fear of its being used against the motorist, it was probably honest reporting. Hence, use has been made of information on speeds and other details of accidents not previously tabulated. In comparing the efficiency of belts of different types, it has been assumed that the probability of an accident of a particular kind of severity is independent of the type of belt.

Types of Accidents

Accidents have been divided into five types, shown in Fig. 1, as follows:

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*G. Grime, "Accidents and Injuries to Car Occupants Wearing Safety Belts," Automobile Engineer (London, 1968). Reprinted with permission.

Fig 1

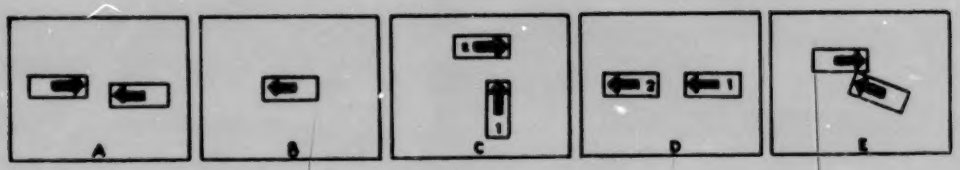

Fig. 1: Types of accident: A head on, B single vehicle, C side impact, D rear impact, E side swipe. In accident types C and D, 1 is the striking vehicle, and 2 the struck vehicle

Head-on impacts between vehicles, which are regarded as including not only accidents in which the vehicles were travelling in opposite directions, but also the striking vehicles in rear-end accidents, in which the vehicles were travelling in the same direction, and the striking vehicles in intersection accidents, in which the vehicles were travelling at right angles or nearly so; in parts of this paper, head-on impacts with fixed objects in single-vehicle accidents have also been included under the general title of head-on impacts.

Single-vehicle accidents, in which only one vehicle is usually involved although the presence of another vehicle may sometimes provoke the accident; they may result either in overturning or in impact with a fixed object, or both.

Side impacts, usually almost at right angles, caused by accidents at intersections.

Side swipes, when one vehicle strikes a glancing blow on another, almost always travelling in the opposite direction on the same road.

Rear impacts, in which the vehicle, often stationary, is struck from the rear. In many instances, the struck vehicle then strikes the rear of another vehicle.

The numbers of accidents of these types are given in Table 1. Head-on accidents are the most numerous; during many single-vehicle accidents, head-on collisions with fixed objects occur, and if these are added (134), head-on impacts are the principal feature of 62 per cent of the accidents reported. Single-vehicle accidents were the next most important class, and accounted for nearly one-third of the cases; almost all overturning--13 per cent out of 15 per cent--occurred in single-vehicle accidents. In spite of the reservations expressed earlier concerning bias in the sample, the percentages in Table 1 are in reasonable agreement with other estimates of the relative frequencies of accidents of the various types.

TABLE 1 NUMBERS OF ACCIDENTS OF VARIOUS TYPES

Accident type	Number	Per cent*	Number over-turning	Per cent* over-turning
Head-on between two vehicles	329	43.8	2	0.3
Single vehicle	232†	30.9	97	12.9
Intersection accidents, struck cars	70	9.3	9	1.2
Rear-end collisions, struck cars	87	11.6	5	0.7
Side swipes	33	4.4	1	0.1
All together	751	100	114	15.2

*Percentages of the total number of accidents (751).
†In 134 single vehicle accidents the car had a head-on collision with a fixed object.

TABLE 2 INJURIES AND TYPE OF ACCIDENT--ALL BELT WEARERS

Accident type	No injury		Slight injury		Serious injury	
	Number	Per cent	Number	Per cent	Number	Per cent
Head-on between two vehicles	252	53	188	40	35	7
Single vehicle	205	62	105	31	24	7
Intersection accidents, struck cars	60	61	34	34	5	5
Rear-end collisions, struck cars	83	63	47	36	1	1
Side swipes	34	60	14	24	9	16
All together	634	59	388	35	74	7

Head-on impacts are of particular interest, not only because they form such a high proportion of the total number of accidents, but also because the main function of a safety belt is to give protection against them. However, belts are tested only in conditions simulating symmetrical head-on impacts, whereas in practice most head-on impacts are off-centre. It is important to know whether this makes any difference to their efficiency. Starks gives the following figures for the proportions of frontal impacts of various types when vehicles--including goods vehicles--strike fixed roadside obstacles: centre head-on 45 per cent; left side head-on 29 per cent, right side head-on 18 per cent, front right side 8 per cent. In the present sample of accidents, head-on impacts--including those observed in single-vehicle accidents--were distributed as follows: centre head-on 20 to 40 per cent; off-centre 60 to 80 per cent, about two-thirds of these being to the right-hand side of centre; the uncertainty in the figures arises because in a large number of reports the exact position of impact was not stated.

When the area of impact of a head-on collision is well away from the longitudinal axis of the car, there is obviously a tendency for the vehicle to rotate as well as to decelerate. At first sight, this might be expected to produce injury by impact against the side of the vehicle, since safety belts afford practically no side restraint to the upper body. When the impact is to the right side of centre, injury to the driver would appear likely and when to the left side, to the passenger. However, it can be shown that, because the duration of impact is so short--about 1/10 sec--the car rotates very little while the belt is stretching, and the belt has time to work normally before the car has swung round. Supporting evidence is to be found in a paper by Rutley and Cooke who examined 95 cases of head injury to unbelted occupants of cars in which it was possible to establish the part of the vehicle struck by the head; in 90 per cent of these cases, the object struck was in front of the occupant. In the present investigation, there were 63 head-on accidents in which the driver or the front seat passenger, or both, suffered head injuries, 68 in all. In five of these accidents, the car was said to have rotated, and in three out of the five, the resulting head injuries (3) might have been caused by impact with the side of the car; in only one was it probable. Altogether, there were about 300 head-on accidents--including those in which no injury resulted--in which some rotation might have occurred.

Injuries to Wearers of Safety Belts

As might be expected, the percentages of occupants wearing safety belts injured in accidents varied with the type of accident. Tables 2 and 3 give the relevant figures.* Head-on impacts produced the highest

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*In Table 2 cuts, lacerations, strains, bruises, belt bruises and belt burns were classed as slight injuries; concussions, fractures, and internal injuries were classed as serious. The classifications are not completely satisfactory as indications of accident severity, but have the advantage of requiring no exercise of judgment.

percentages of injury to those wearing belts. The numbers of serious injuries were usually too small for significant* differences to be detected, but for slight plus serious injuries, head-on impacts resulted in significantly higher percentages of injuries than single-vehicle accidents, or the last three types of accident taken together.

Overturning is sometimes referred to as a particularly dangerous type of accident. Almost all overturning occurred in single-vehicle accidents, and if the overturning accidents are separated from the remainder, only 31 per cent of the belt-wearers--124 in number--were injured, 5 per cent seriously (as shown in Table 3). In the remaining single vehicle accidents, 43 per cent of the 210 persons wearing belts were injured, 9 per cent seriously; a disproportionate number of these injuries occurred in 17 cases of side impact, causing 16 injuries, including five which were serious.

Another type of side impact, the side-swipe, Table 2, also appeared to give rise to a high proportion of serious injuries, but in this instance also the numbers were too small for firm conclusions to be drawn.

Whether slight or serious, the injuries were of two types: first, injuries caused by striking some part of the car; secondly, those due to the forces imposed by the safety belts on their wearers. About two-thirds, 64 per cent, were of the first type, and one-third, 36 per cent, of the second. Tables 4 and 5 give the numbers of slight and serious injuries to the various parts of the body, separately for the driver and the front seat passenger. Table 4 refers to injuries caused by striking parts of the car--injuries to head and face, arms, legs, knees and cuts and bruises--and Table 5 to injuries caused mainly by belts--neck, shoulder, chest, ribs and belt bruises. Single diagonal belts were excluded, since they produce a different pattern of injury. The data are therefore derived from accidents to drivers and passengers wearing lap-and-diagonal, pillar-mounted belts, either of the static or the inertia reel type. Table 6 shows the numbers of injuries to the various parts of the bodies of the drivers and passengers, separately for the three different types of belts. For the present, however, attention will be confined to Tables 4 and 5.

Injuries Caused by Striking Some Part of the Car

Head injuries. Whereas the most important function of safety belts is to protect their wearers from head injury, in this respect they are not yet as efficient as they might be. From Table 4 it can be calculated

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*Except where otherwise stated, the term significant denotes the 5 per cent level of significance, and "highly significant" or "very significantly" the 2 per cent level.

TABLE 3 SINGLE VEHICLE ACCIDENTS INVOLVING BELT WEARERS

Single-vehicle accident type	No injury		Slight injury		Serious injury	
	Number	Per cent	Number	Per cent	Number	Per cent
Overturning	85	69	33	26	6	5
All other single vehicle accidents	120	57	72	34	18	9
Side impacts	1	6	11	65	5	29
Head-on	119	62	61	31	13	7
All single-vehicle accidents	205	62	105	31	24	7

TABLE 4 INJURIES CAUSED BY STRIKING PARTS OF THE CAR

		Head and face	Arms	Legs	Knees	Cuts and bruises
Drivers	Number†	82(15)	40(10)	38(4)	50(3)	72
(646)	Per cent*	13(2)	6(2)	6(1)	8(0.5)	11
Passengers	Number	22(5)	8(3)	35(4)	16(0)	42
(314)	Per cent	7(2)	3(1)	11(1)	5(0)	13

TABLE 5 INJURIES CAUSED BY BELTS

		Neck	Shoulder	Chest	Ribs	Belt bruises
Drivers	Number†	46(0)	19(5),	28(2)	25(8)	16
(646)	Per cent*	7(0)	3(1)	4(0.5)	4(1)	3
Passengers	Number	18(1)	16(4)	17(1)	14(7)	22
(314)	Per cent	5(0.5)	5(1)	5(0.5)	5(3)	7

†Numbers and percentages of serious injuries are given in brackets.
*Percentages are in relation to the total numbers, injured and uninjured, of drivers and front seat passengers wearing belts.

TABLE 6 INJURIES TO BELT WEARERS

	Head and face	Neck	Shoulder	Chest	Ribs	Arms	Legs	Knees	Internal injuries	Cuts and bruises	Belt bruises
DRIVER											
Lap-and-diagonal (448)	67(12)*	31(0)	12(4)	24(2)	20(7)	29(8)	28(2)	37(3)	5	52	12
Lap-and-diagonal with inertia reel (198)	15(3)	15(0)	7(1)	4(0)	5(1)	11(2)	10(2)	13(0)	1	20	4
Diagonal (98)	8(1)	6(0)	3(0)	10(2)	2(2)	2(0)	6(0)	11(1)	1	20	0
PASSENGER											
Lap-and-diagonal (215)	16(4)	11(1)	11(3)	15(1)	10(5)	5(2)	26(2)	12(0)	3	29	19
Lap-and-diagonal with inertia reel (99)	6(1)	0(0)	5(1)	2(0)	4(2)	3(1)	9(2)	4(0)	1	13	3
Diagonal (38)	3(1)	3(1)	0(0)	2(1)	1(1)	3(2)	5(0)	5(1)	1	5	0

*The numbers of serious injuries are given in brackets; the first number gives the total of a:l injuries.

that head or face injuries occurred to about 25 per cent of those injured. Unfortunately, in most cases it was not possible to discover with certainty from the reports which part of the vehicle had been struck by the head. However, a comparison of the relative frequency of head injuries to the driver and front seat passenger throws some light on this question. There were 26 accidents in which both the driver and passenger were wearing belts, and in which one or both sustained a head injury. In 20 accidents, the driver had a head injury, whereas the passenger was injured in only 10; the difference is highly significant. Table 4 gives the same answer, but suggests that the difference in the percentage of head injuries may be confined to slight injuries. The obvious difference in the environment of driver and passenger is the presence of the steering wheel, and this is probably the object most frequently struck by the driver's head.

This conclusion needs to be confirmed by further investigation, since it has a bearing on safety belt design, as well as on the placing of the steering wheel. In respect of the design of static lap-and-diagonal belts, the present tendency is to produce a belt the lap part of which is likely to be worn reasonably tightly, whereas the top part has more slack. Such belts may be expected to reduce knee injuries and submarining, but may result in the upper part of the body pivoting about the waist and rotating downward so that, in extreme cases, the steering wheel may be struck by the head.

The superiority of the single diagonal belt in preventing head injuries, established in two investigations by the Road Research Laboratory, may be the result of the lack of lower body restraint. Fig. 2 is a diagrammatic representation of the two types of belt. In

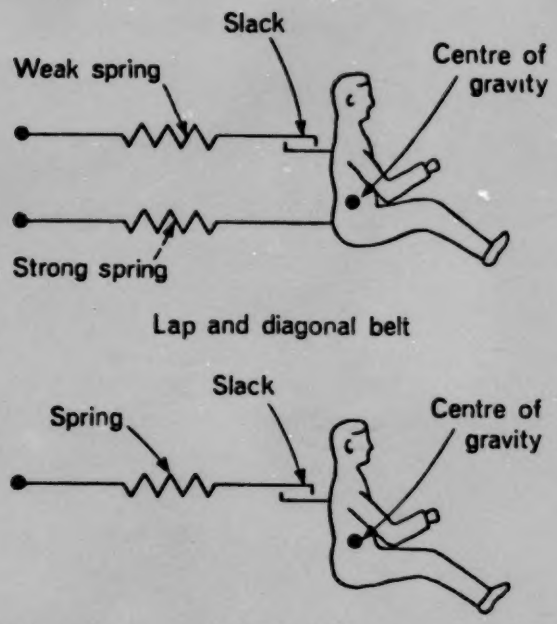

Fig. 2. Diagrammatic representations of two types of safety belts.

the present lap-and-diagonal configuration, the restraining webbing may be represented by a stiff spring below the centre of gravity of the wearer, and a weaker one above it with some slack; the single diagonal belt is represented by only one spring above the centre of gravity. In the first case, the resulting rotation of the upper part of the body and head in a head-on impact is forward towards the steering wheel or other hard object, and in the second it is backward and away from the steering wheel. In both cases, the rotation is combined with a general forward movement.

The results reported for inertia reel belts suggest that slack in the shoulder loop is a more important factor than the flexibility of the loop, since it was found that drivers wearing these belts had a very significantly lower incidence of head injuries. An inertia reel mechanism may be expected to keep the shoulder strap tight against the wearer's body, and so greatly reduce slack, but to have a rather higher flexibility in the shoulder loop than an ordinary lap and diagonal belt.

It is suggested that if static instead of inertia reel belts are used, an improvement might perhaps result if the flexibilities of the two parts of the lap-and-diagonal belt were changed so that more movement was allowed in the lap part and relatively less in the upper, diagonal webbing. This could be done only with the co-operation of car manufacturers, which would have to provide more knee room and padding

of the right type in front of the knees. The placing of the steering wheel in relation to the driver's head also requires further study of a more detailed nature than is possible from the data presented in this report.

About three quarters (81) of the head and face injuries occurred in head-on impacts, including some in single-vehicle accidents, almost all the remainder (23) occurred in single-vehicle accidents without a head-on impact, in intersection collisions, or side swipes. There were only three slight head injuries in the 92 rear-end collisions. This remaining quarter of the head injuries is caused by accident conditions for which lap-and-diagonal safety belts afford comparatively little protection. About one-third (8) occurred in single vehicle accidents in which overturning or side impact was a feature, and where the lack of side restraint for the upper body was probably important. In the remaining 12, comprising intersection accidents--side impacts--and side swipes, deformation of the side of the car may have had more influence. This is a small but important area for future research.

Leg and Knee injuries. In spite of the occurrence of some head injuries, present day safety belts afford considerable protection against such injuries. Lister and Neilson found that, whereas unbelted occupants of front seats (74) had head or neck injuries in 47 per cent of the accidents in which they were involved, those wearing lap-and-diagonal belts had these injuries in only 14 per cent of accidents, a reduction of more than 3 to 1. The combination of safety belt and car is less effective in reducing the incidence of leg and knee injuries, the reduction being about 2 to 1. Leg and knee injuries are listed separately in Table 4; all serious injuries were fractures and the slight ones were cuts and bruises. Knee and leg injuries may be caused in two different ways, either by striking a sharp or hard part of the car because there is insufficient room for forward movement of the lower part of the body, or by an upward flailing movement of the legs. In respect of knee and leg injuries, 84 per cent occurred in accidents in which a head-on impact occurred.

The passenger had very significantly more leg injuries than the driver, but there was an indication that in head-on impacts the driver had proportionately more knee injuries than the passenger. The difference in leg injuries may come about because there is more freedom for the passenger's legs to flail upwards than for the driver's legs to move in this way; the driver's legs may be impeded by the steering column, and the brake and clutch pedals. Leg and knee injuries make a substantial contribution to the total of serious injuries to wearers of safety belts, since about one per cent of those involved in the reported accidents had a leg or knee fracture. It should be possible to prevent such injuries by removing all rigid obstructions in front of the occupant's knees, and replacing them with suitably padded, crushable members. Enough information is already available for the crushing properties of such members to be specified. To reduce injury when legs flail around, padding would have to be placed underneath as well as in front of the dash, or some method to prevent this movement would have to be devised.

Arm injuries. Fractured arms occurred in 13 instances out of 960, that is, to 1.4 per cent of those wearing belts. Drivers had a higher percentage of arm injuries, both slight and serious, than front seat passengers; the difference in slight injuries was highly significant. As with head injuries, it is highly probable that the presence of the steering wheel is responsible for the difference.

Injuries Due to the Force Exerted by the Belt

Many neck injuries, most shoulder, chest, and rib injuries, belt bruises and some internal injuries can be ascribed to pressure exerted by the belt.

Neck injuries. Neck injuries may be produced in three ways: by forward movement of the head without striking any part of the car; as the result of the head striking a part of the car when the safety belt has stretched; by rearward movement of the head when the car is struck at the rear--whiplash injuries. Of the two mechanisms of injury that apply to forward movement, the first-mentioned is the more common, since in only six instances out of 31 was the neck injury accompanied by a head or face injury. Most neck injuries in head-on impacts are, therefore, due to the forces imposed on the neck by the rapid deceleration of the head. However, there was only one serious neck injury; this occurred in a head-on impact from a speed of 45 to 50 mile/h with a stationary lorry, when the passenger in the front seat suffered a broken neck as well as a fractured rib. The injuries were very probably caused, directly or indirectly, by impact from the left-hand rear passenger, who was killed. The driver, who had no one behind him, escaped with a strained neck and minor bruises. Neck injuries were about equally frequent for drivers and passengers. In only six instances were the neck injuries said to be due to direct contact with the belt; they comprised three burns, one cut and two bruises; all occurred in severe accidents at high speeds. It may be concluded that, although some neck injury to belt wearers in head-on accidents is not uncommon, the injuries are rarely serious.

Most neck injuries that occurred in other types of accident were of the whiplash type (26 out of 32), and were caused in 76 rear-end collisions in which 109 people wearing lap-and-diagonal belts were involved. None of the injuries was serious; they were described as stiff, sore, or strained necks. It should be noted, however, that out of 22 occupants involved in another 16 rear-end accidents, but wearing single diagonal belts and therefore not included in the analysis, one had a fractured cervical disc; the type of belt has, of course, no influence on the frequency of occurrence of this type of injury. In the whole sample of 131 people in 92 cars struck from the rear, only one person had a serious neck injury. Neck injuries that occur in rear end collisions could be prevented by fitting head-rests, and the necessity for them becomes greater the stronger the seat back is made.

Shoulder, chest and rib injuries. These injuries are usually caused by the restraining pressure exerted by the belt, although in some instances they were reported to be caused by striking the steering wheel. However, the figures in Table 5 do not suggest that the steering wheel has an adverse effect, since injuries to the driver's chest were reported slightly less frequently than those to the passenger's chest; it is possible that the driver's arms may act as padding between his chest and the wheel. Shoulder and rib injuries have been separated from chest injuries because they occur at the two places in which the curvature of the belt changes suddenly, and where the forces on the body are therefore greater than elsewhere. Shoulder, chest or rib injuries were sustained by about 11 per cent of all those wearing lap-and-diagonal belts; about three-quarters occurred in head-on collisions, and about one-quarter of these injuries were fractures. Very little can be done, by immediate action, to reduce the incidence of these injuries, most of which arise from the high pressures exerted by belts; in the long term, it may be possible to make changes in the design of the whole protective system which will raise the impact speeds at which these injuries begin to occur.

TABLE 7 EFFECTIVENESS OF SAFETY BELTS IN PROTECTING DRIVER AND FRONT SEAT PASSENGER--LAP-AND-DIAGONAL AND INERTIA-REEL BELTS

		No injury	Slight injury	Serious injury	Totals
Drivers	Number	392	211	43	646
	Per cent	61	32	7	100
Passengers	Number	171	121	22	314
	Per cent	54	39	7	100
Both together	Number	563	332	65	960
	Per cent	59	34	7	100

TABLE 8 EFFECTIVENESS OF VARIOUS TYPES OF BELT

Injury	Lap-and-diagonal	Lap-and-diagonal with inertia reel	Diagonal	All types
None	365(55)	198(66)	71(52)	634(58)
Slight	247(37)	85(29)	56(41)	388(35)
Serious	51(8)	14(5)	9(7)	74(7)
All types	663(100)	297(100)	136(100)	1096(100)

The figures are for the number of injuries, with the percentages in brackets.

TABLE 9 INJURIES TO WEARERS OF LAP-AND-DIAGONAL AND LAP-AND-DIAGONAL INERTIA REEL BELTS

Belts	Head and face	Neck	Shoulder	Chest	Ribs	Arms	Legs	Knees	Internal injuries	Cuts and bruises	Belts bruises
Lap-and-diagonal Number†	83(16)	42(1)	23(7)	39(3)	30(12)	34(10)	54(4)	49(3)	8	81	31
Per cent*	12.5(2.4)	6.3(0.2)	3.5(1.0)	5.9(0.5)	4.5(1.8)	5.1(1.5)	8.1(0.6)	7.4(0.5)	1.2	12.2	4.7
Lap-and-diagonal with inertia reel Number	21(4)	21(0)	12(2)	6(0)	9(3)	14(3)	19(4)	17(0)	2	33	7
Per cent	7.1(1.3)	7.1(0)	4.0(0.7)	2.0(0)	3.0(0)	4.7(1.0)	6.4(1.3)	5.7(0)	0.7	11.1	2.4

†Numbers and percentages of serious injuries are given in brackets.
*Percentages are in relation to the total numbers, injured and uninjured, of drivers and front seat passengers wearing belts (663 lap-and-diagonals, and 297 inertia reel belts).

Belt Bruises. The pressure of the safety belt also causes bruises, which were reported twice as often for passengers as for drivers. The difference, which is highly significant, may be at least partly accounted for by the preponderance of men as drivers and women as passengers in the front seat. Recent counts in the London area indicate that over 80 per cent of drivers at all times of day are men; between 35 to 70 per cent of passengers are women, according to the place and the time of day. Part of the difference may also be due to the cushioning effect of the driver's arms. As previously mentioned, drivers have significantly more arm injuries than do passengers.

Internal injuries. It is difficult to determine how all twelve cases of internal injury were caused: at least six occurred because the side or front of the car was pushed in, and in one, the car overturned. In five cases the injury may have been due to the belt: in two of these the buckle was suggested as the cause of injury; in another--a head-on collision--the driver was unhurt, but the front seat passenger had injuries to the spleen, the ribs and the lungs, probably caused by being crushed between the belt and the back of the seat by the impact of the unbelted passenger in the rear seat. In the remaining two accidents, in both of which the front seat passengers had spleen injuries, the injuries might have been due to belt forces, pressure from the buckle, or impact with the fascia.

TABLE 10 COMPARISON OF INJURIES TO OCCUPANTS OF FRONT AND REAR SEATS

Persons involved	No injury		Slight injury		Serious injury	
	Number	Per cent	Number	Per cent	Number	Per cent
Driver and front seat passenger wearing belts	123	67	54	29	8	4
Rear seat passengers not wearing belts	87	52	68	40	14	8

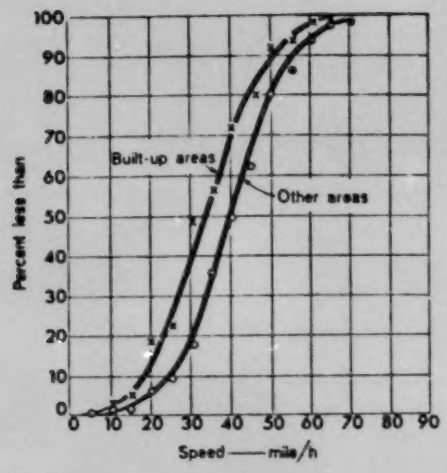

Fig 4

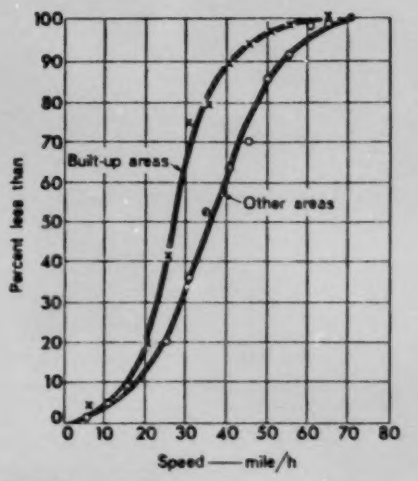

Fig 5

Fig. 4. Speeds reported in single-vehicle accidents involving 165 cars in which there were no passengers on the rear seats.

Fig. 5. Speeds reported for 218 cars involved in head-on accidents. No passengers were carried on the rear seats.

Fig. 6. The reported speeds of 48 struck cars suffering side impacts at intersections.

Fig. 7. The reported speeds of 66 struck cars involved in rear-end accidents.

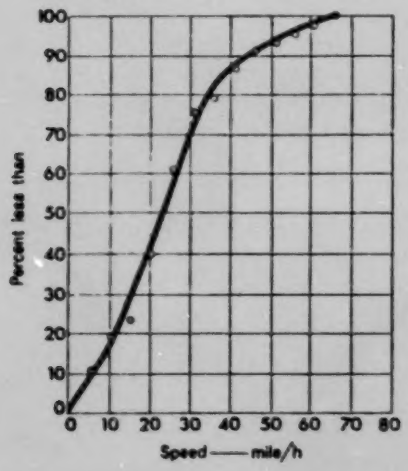

Fig 6

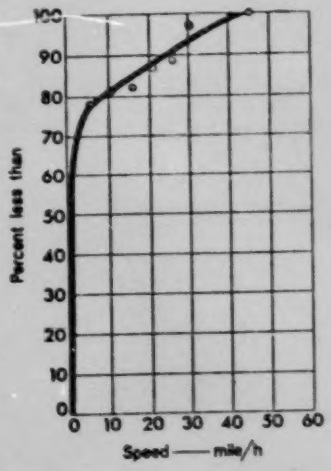

Fig 7

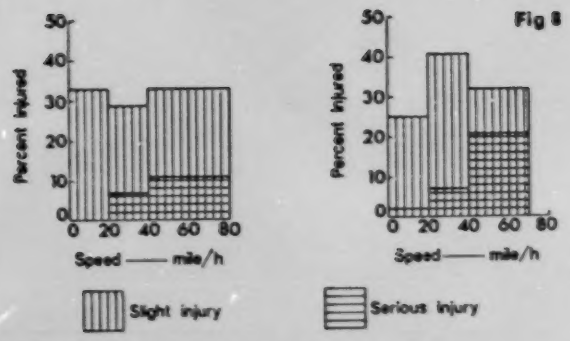

Fig. 8. These graphs show the relationship between the speeds of the cars and injuries to the occupants, both drivers and passengers. The graph on the left is for single-vehicle accidents, involving 222 occupants, and that on the right for head-on accidents, in which 304 occupants were involved.

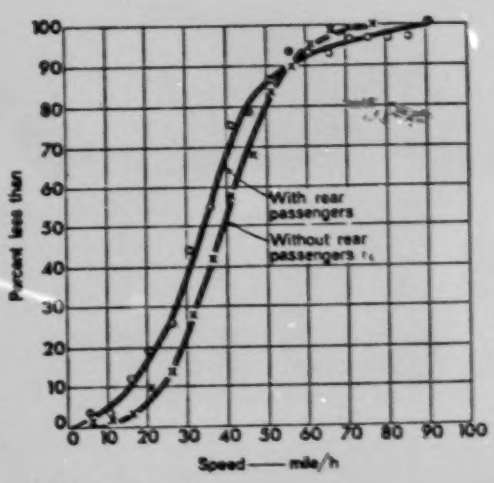

Fig 9

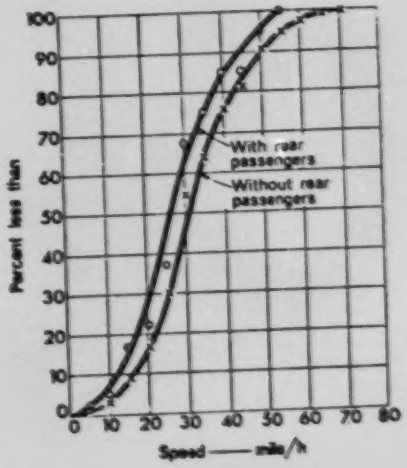

Fig 10

Fig. 9. Speeds reported for single-vehicle accidents to cars with and without passengers on the rear seats.

Fig. 10. Speeds reported for head-on accidents to cars with and without passengers on the rear seats.

OBJECTIVE: Compare the injuries of belted and unbelted passengers in a collision, reported in graphs or tables.

THE EFFECTS OF SEAT BELT LEGISLATION: THE SASKATCHEWAN EXPERIENCE*

Carl Shiels

Injuries and Fatalities

In the final analysis the test of seat belt legislation comes with the injury and fatality statistics. In Saskatchewan these statistics have been monitored very closely during the first year and are presented in Table V. When compared to the corresponding twelve month period prior to the introduction of the law, reductions of 9.2% for vehicle occupant injuries and 19.5% for vehicle occupant deaths have been recorded. This has been in spite of a 10.0% increase in vehicle crashes during that time.

As statisticians are quick to point out, such short-term analysis is always suspect unless consideration is given to longer-term fluctuations and trends. Figures 1 and 2 show the injury and fatality trend in Saskatchewan during the period 1966 to 1977, as well as projected injury and fatality figures for 1978 based on the first 6 months experience and adjusted for half-year differences.

Some uncertainty as to trend arises out of the drop in injuries recorded during 1976. Whether this reflected a genuine downward trend produced by some unidentified influences, whether it was a random statistical fluctuation or whether the pre-legislation seat belt publicity campaign affected belt use rates is a matter of speculation. However, a time series analysis on the figures up to and including 1976 indicates that 1977 injuries were down 11% and fatalities were down 5% from what would have been expected. Even more impressive is the finding that for the first 6 months of 1978 injuries and deaths were down by 38.6% and 23.3% respectively compared to what would have been expected based on the 12 years prior to and including 1977. The probability of obtaining such a reduction purely by chance was determined to be 0.7% in the case of injuries and 3.7% in the case of fatalities.

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*Carl Shiels, "The Effects of Seat Belt Legislation: The Saskatchewan Experience." Paper presented to: 10th Annual Safety Conference. Canada Safety Council (October, 1978). Reprinted with permission.

TABLE V

SASKATCHEWAN ACCIDENT STATISTICS

(12 Months Pre- and Post-Legislation)

TOTAL ACCIDENTS	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	TOTAL
July 1, 1976-June 30, 1977	2409	2479	2751	2351	2800	3308	1882	2252	2050	2145	2356	2284	29 067
July 1, 1977-June 30, 1978	2388	2638	2753	2790	3168	4488	1752	2332	2602	2398	2371	2299	31 979
% Change	- 0.9	+ 6.4	+ 0.1	+18.7	+13.1	+36.0	- 6.9	+ 3.6	+26.9	+12.[illegible]	+ 0.6	-10.0	
Cumulative % Change since July 1/77	- 0.9	+ 2.8	+ 1.8	+ 5.8	+ 7.4	+13.0	+11.1	+10.3	+11.8	+11.8	+10.8	+10.0	
VEHICLE OCCUPANT INJURIES													
July 1, 1976-June 30, 1977	920	920	901	766	756	716	254	506	517	686	703	717	8 362
July 1, 1977-June 30, 1978	866	855	789	724	812	848	201	390	495	476	572	587	7 615
% Change	- 5.9	- 7.1	-12.5	- 5.5	+ 7.4	+18.0	-20.9	-22.9	- 4.3	-30.6	-18.6	-18.1	
Cumulative % Change since July 1/77	- 5.9	- 6.5	- 8.4	- 7.4	- 5.1	- 1.7	- 2.6	- 4.4	- 4.4	- 7.0	- 8.1	- 8.9	
OCCUPANT INJURIES PER ACCIDENT													
July 1, 1976-June 30, 1977	.382	.371	.328	.326	.270	.216	.135	.225	.252	.320	.298	.314	
July 1, 1977-June 30, 1978	.363	.324	.287	.259	.256	.189	.115	.167	.190	.199	.241	.321	
% Change	- 5.0	-12.7	-12.5	-20.4	- 5.1	-12.5	-14.8	-25.8	-24.6	-37.8	-19.1	+ 2.1	
VEHICLE OCCUPANT FATALITIES													
July 1, 1976-June 30, 1977	29	29	32	32	23	15	13	13	12	30	16	13	257
July 1, 1977-June 30, 1978	31	34	15	29	13	16	13	11	10	4	15	16	207
% Change	+ 6.9	+17.0	-53.0	- 9.4	-44.0	+ 6.7	0	-15.0	-16.7	-86.7	- 6.3	+23.1	
Cumulative % Change since July 1/77	+ 6.9	+12.0	-11.1	-10.7	-15.9	-13.8	-12.7	-12.9	-13.1	-22.8	-21.7	-19.5	

It was hoped that some insight into the reliability of the drop in injury statistics might be gained by comparing injury figures from Alberta as seen in Figure 1. Injuries for that province follow the Saskatchewan trends very closely from 1970 to 1976. However in 1977 there was a marked drop in injuries by about 20%. This may be accounted for, at least in part, by a similar drop in the total number of accidents. The 1976 drop in accidents is largely due to an increase in the cost of repair threshold for reporting accidents which took place in January 1976. No such drop in accidents was noted for Saskatchewan in 1977.

FIGURE 1

VEHICLE OCCUPANT INJURIES
(Saskatchewan, Alberta, Manitoba)

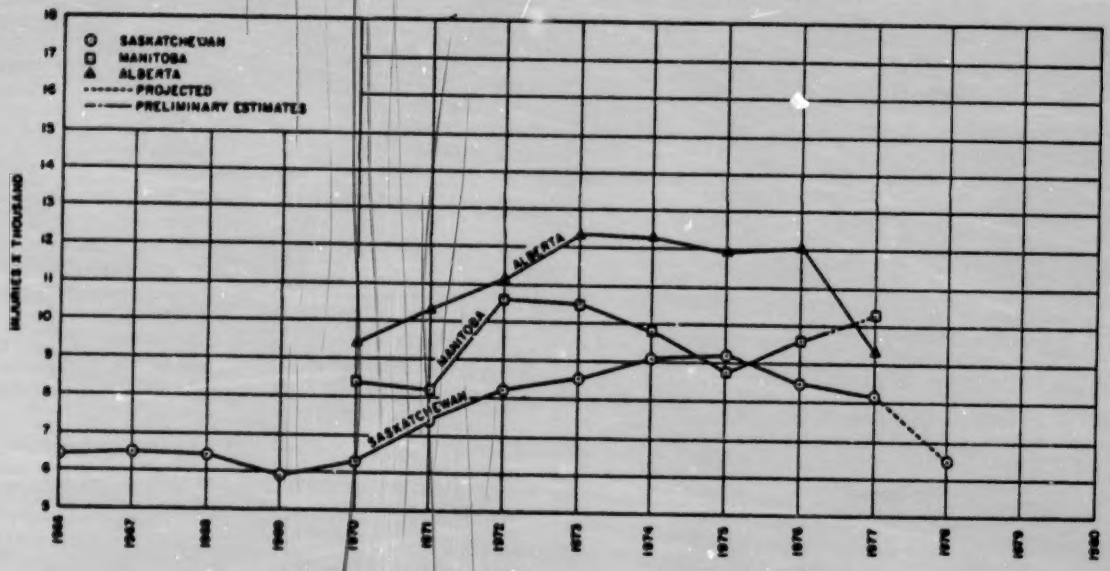
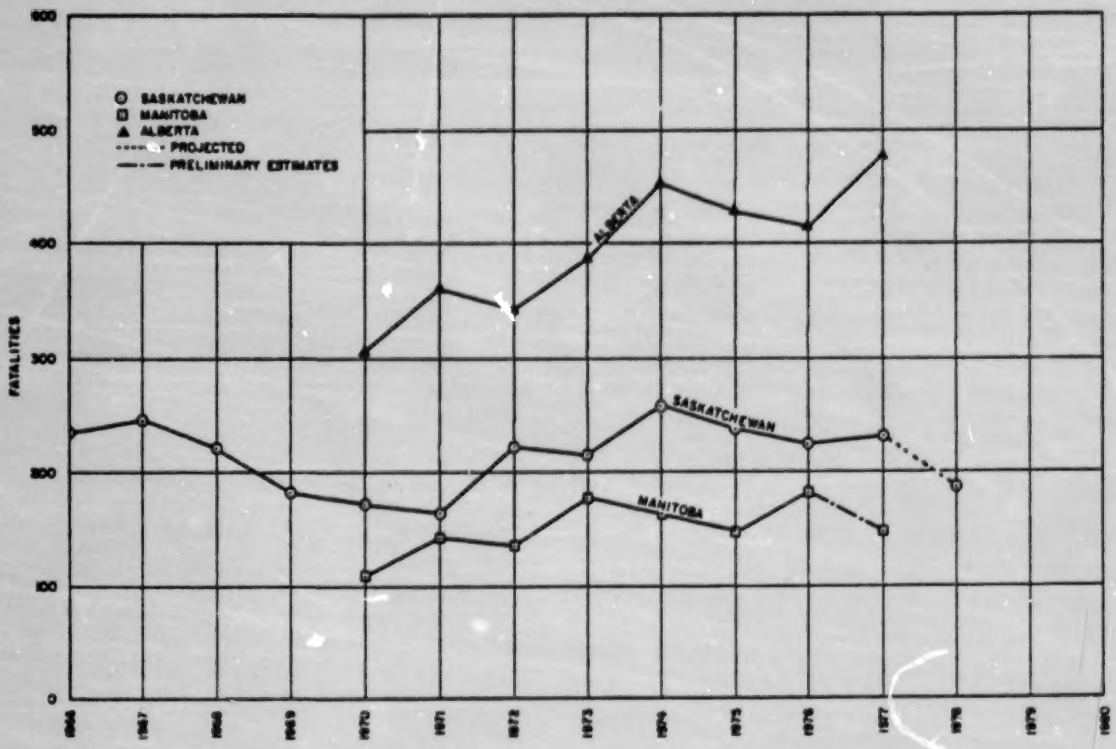


FIGURE 2

VEHICLE OCCUPANT FATALITIES
(Saskatchewan, Alberta, Manitoba)

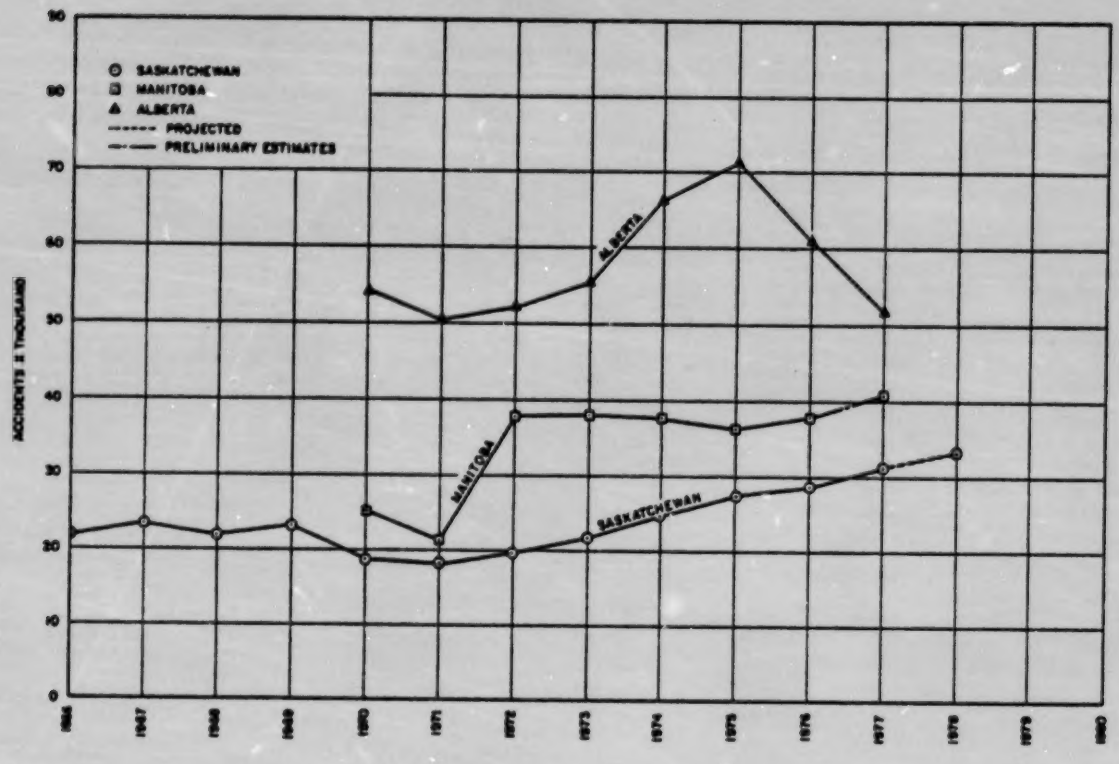


Manitoba injury statistics were found to be even more erratic with an unexplained downward swing which hit a low in 1975 and then rebounded upward in 1976 and 1977 (Figure 1).

Attempts to expand upon the injury reductions in Saskatchewan have been largely frustrated by the fact that for purposes of policy reporting, an injury is loosely defined at the lower level as whatever the police officer feels worth noting and at the upper level as anything which did not cause death. Earlier studies have indicated that many persons who would otherwise have been seriously injured would still report injuries when belts are worn, although the severity of injury would have been reduced. Currently available accident statistics do not provide any insight into this shift in injury level.

FIGURE 3

VEHICLE ACCIDENTS
(Saskatchewan, Alberta, Manitoba)



In an attempt to verify that this shift was in fact taking place, all accident reports involving injury from the months of September to December 1977 were examined. Based on the rather vague descriptions of injury reported by police an injury severity code was assigned using the American Medical Association's Abbreviated Injury Scale (A.I.S.).[1] These injury levels were then tabulated according to belt use. As shown in Table VI, a shift in injury levels did appear to have taken place when belts were worn. The ratio of A.I.S. 2 and greater injuries to A.I.S. 1 injuries for persons using lap belts only or lap/shoulder restraints was approximately half of that for unrestrained persons.

Admittedly this analysis is very crude. It does nonetheless tend to confirm what one would expect by way of injury reductions.

TABLE VI

INJURY LEVEL VS. INDICATED RESTRAINT USE - SEPTEMBER-DECEMBER, 1977

Abbreviated Injury Scale (AIS)

Restraint Used	1 Minor	2 Moderate	3 Severe	4 Serious	5 Critical	AIS 2 to 5 / AIS 1
None Used/ Available	762	102	27	4	2	.177
Lap Belt Only	403	23	9	3	0	.087
Lap and Shoulder	373	20	6	3	0	.078

Summary and Conclusion

Because seat belt legislation affects virtually the entire population, its influence in terms of public attitude and behaviour and in terms of reduced deaths and injuries can be substantial.

In Saskatchewan public support for the law increased from 54.3% prior to the law to 75.1% thirteen months after proclamation of the law.

This experience is consistent with previously reported findings from Ontario.(2) An explanation of this phenomenon will be left to the social and behavioural psychologists. Whatever the reason, legislators can probably take heart from the fact that violent and/or significant opposition is bound to be relatively short-lived.

In Saskatchewan seat belt use by front seat occupants increased from 24% in May 1977 to 60.2% in May 1978, with a high of 73.4% having been recorded in October 1977 shortly after enforcement began. Apparently some 13% of the motoring public respond only when a high level of enforcement is expected.

Apparently the existence of the law has little effect on the behaviour of persons not directly affected. It does not, as might be hoped, act as a catalyst or guideline for behavioural changes beyond the actual scope of the law. Indeed, providing an exemption for rear seat passengers may imply that it is less important for rear seat passengers to wear seat belts.

Similarly, the exemption for children under five years may suggest that use of adult belts for children is somehow more dangerous than leaving the child unrestrained. Consequently less than 15% of children under five were noted to be restrained during the May 1978 survey.

During the first 12 months with Saskatchewan's belt law in effect, vehicle occupant injuries were down by 8.9% and deaths were down 19.5% compared to the previous 12 month period. This was in spite of a 10.0% increase in the number of collisions reported.

On a calendar year basis, 1977 injuries and deaths were down 11.0% and 5.3% respectively from what would have been expected based on the previous 11 years. This of course would reflect only six months of significantly increased belt use.

Based on the first six months of 1978 injuries and deaths are down by 38.6% and 30% respectively compared to what would have been expected based on the previous 12 years.

References

(1) "The Abbreviated Injury Scale (1976 Revision)". Developed by the Joint Committee on Injury Scaling of the AMA, SAE, AAAM. Published of Health and Safety Associates, Morton Grove, Ill., 1976.

(2) Notes presented to 1978 Federal/Provincial Conference on Road Safety, Ottawa, May 25-26, 1977.

OBJECTIVE: Compare the injuries of belted and unbelted passengers in a collision, reported in graphs or tables.

CAUSES OF DEATHS IN AUTOMOBILE ACCIDENTS*

Donald Huelke and Paul Gikas

One hundred and thirty-nine automobile accidents, in which 177 occupants died, were studied over a four-year period. Ejection of the occupant from the car was found to be the leading cause of death. At least 50% of the drivers at fault had been drinking prior to the collision. Collisions at the door caused a significant number of fatalities by collapsing and compromising the passenger compartment. Impacts with the steering assembly and instrument panel ranked high as causes of fatalities. It is postulated that 40% of those killed could have survived had seat belts been worn and an additional 13%, if seat belts and shoulder belts had been used.

This report gives the results of four years of investigations of fatal automobile accidents in the Washtenaw County area of southeastern Michigan, a project which began on Oct 31, 1961. For this study the authors were on 24-hour call with all the police agencies of the country: the Sheriff's Department, the Michigan State Police, and the Ann Arbor and Ypsilanti City Police. Whenever the police patrolled an on-the-scene fatal automobile accident, one of us (D.F.H.) was called to the scene. When the services of a medical examiner were needed, usually the coprincipal investigator was called. For this study, only occupants of automobiles were considered; accidents involving occupants of large trucks, cars with trains, pedestrians, or those involving motorcycles are not included, although such accidents were investigated. Publications on various aspects of this study have been presented elsewhere.[1-14] The data for this report are based on 139 fatal automobile accidents in which 177 occupants were killed.

Method

Whenever the principal investigator arrived at the scene of the accident, photographs were taken (35 mm, color) of the final position of the vehicles, skid marks on the highway, off-roadway wheel imprints, the general area of the accident, the location of the decedent, and exterior and interior views of the car. When a necropsy was performed, photographs were taken of the pertinent injuries.

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*Donald Huelke, and Paul Gikas, "Causes of Deaths in Automobile Accidents," in Journal of the American Medical Association (Vol. 203, Copyright 1968, American Medical Association), pp. 1100-1107. Reprinted with permission.

The determination of fatal injuries is based on the severity of the injury and the organ involved. Obviously, a necropsy increases the accuracy of any assessment of the extent and location of the trauma. Without it, the investigator must rely on evidence from the external examination of the body, which includes visual inspection and palpation. In some cases the external evidence of injury and the cause of death were quite obvious, as in partial decapitation. In such cases one must realize that injuries in the thorax or abdomen may also be of such severity as to be fatal. This lack of complete information in non-necropsy cases limits the correlation between patterns of injury sustained by the victim and the pattern of damage and design of the vehicle. In our study, necropsies were performed on 60% of the decedents.

In almost every accident, the vehicle was inspected again in detail at a later time, always in the daylight; the scene of the accident was also revisited for further study and additional photographs during daylight hours. By combining the information on the collision course of the vehicle, the area of impact with the exterior of the car, the final location of the car with respect to the site of impact, and the description of the occupants' injuries, the "path of body travel" of the occupants were sought out--areas of contact damaged by the occupants, such as a deformed steering wheel, a broken windshield, a deformed instrument panel, frequently with imprints of the occupants' clothes (pants, jacket, etc.)--as well as blood, tissue, and other materials which would aid in identifying the objects impacted.

Some vehicles in this study were not investigated at the scene. In these instances the persons died in, or en route to, the hospital. We were notified of the death by the police, or by the emergency-room or autopsy-room personnel. Photographs of the pertinent injuries of the decedents were taken at the time of necropsy, and the accident was "back-tracked." A copy of the police report was obtained, the scene of the accident visited and photographed, and the vehicle inspected and photographed. In many of the accidents investigated, it was necessary to determine the path of body travel of the decedent, and to determine the attitude of the car or cars at the time of impact; thus the reconstruction of the accident was made in almost all cases. Therefore, location of the vehicle at the time of impact, driver identification, and other pertinent facts have been determined and have been found extremely useful by the police and other interested persons.

Results

Single-fatality accidents were the most frequent in our study, occurring in 111 of the 139 accidents or roughly two thirds of the fatalities (63%). The accidents in which two people were killed occurred less frequently (23%), and triple- or quadruple-fatality accidents, less often (Table 1).

Table 1.--Types and Number of Fatal Automobile Accidents

Type	No.	Killed No.	Killed %
Single fatality	111	111	63
Double fatality	20	40	23
Tripe fatality	6	18	10
Quadruple fatality	2	8	4
Totals	139	177	100

Table 2 indicates the time and day of the week when the fatal accidents occurred. It will seem then that of the 139 accidents, more occurred on Saturday or Sunday than on Thursday or Friday. Fatal accidents occurred less frequently on other days of the week. Of the 177 victims, 46 (26%) died from injuries suffered in accidents between 8 PM and midnight. Thirty-eight (21%) were killed between midnight and 4 AM, and (20%), between noon and 4 PM.

The ages of the drivers who were at fault in the accidents are presented in Table 3. The definition of the driver at fault as used here is the following: in a multiple car accident, one driver was determined to have been at fault and he was identified as the one who crossed an expressway median, traveled the wrong way on the expressway, or violated one or more of the traffic laws (passing on a hill or curve, running a stop light, etc.); in fatal, single-car accidents, the driver of the venicle is listed, for it is felt that he would be considered the driver at fault.

Of the 139 drivers, 15% were under the age of 20 years, and 24% were between 20 and 25 years of age. Thus, approximately 40% of our drivers at fault were under 25 years of age.

Of the 139 drivers at fault, we were able to determine that 69 drivers (50%) had been drinking before the fatal accident (Table 4). Blood samples for alcohol determination were obtained from 35 of these individuals. In all but three, the blood alcohol level was 0.10% by weight or higher (below 0.05%, 3; 0.10% to 0.15%, 7; 0.15% to 0.20%, 11; 0.20%, 11; 0.20% to 0.25%, 9; and 0.25% and above, 5). In 26% of the cases, the driver at fault was determined not to have been drinking before the accident, and in 24% it was not known whether the driver at fault had been drinking previous to the accident.

Table 2.--Time and Day of Week of Fatal Automobile Accidents

Time	Days of the Week: Mon	Tues	Wed	Thurs	Fri	Sat	Sun	Total No. of Accidents	Fatalities: 1	2	3	4	Totals
8 AM-noon	3	1	4	-	1	5	-	14	11	2	-	1	19
Noon-4 PM	2	4	2	2	2	4	10	26	20	5	1	1	37
4 PM-8 PM	3	1	1	4	1	6	4	20	18	2	-	-	22
8 PM-midnight	3	4	2	5	11	7	4	36	25	6	3	-	46
Midnight-4 AM	3	1	3	7	3	5	7	29	24	4	2	-	38
4 AM-8 AM	-	1	2	2	4	3	2	14	13	1	-	-	15
TOTALS	14	12	14	20	22	30	27	139	111	40	18	8	177

Causes of Death

The number of fatalities by seat location and the injury-producing object is presented in Table 5. The four leading causes of death are ejection from the vehicle; impacts with the door or side of the car, impacts with the steering assembly; and impacts with the instrument panel. Other objects were struck less often and are of lower priority.

Ejection.--Ejection from the vehicle was the specific cause of the fatality in 48 of the 177 deaths (27%). Actually, 41% of the victims were ejected from the vehicle but about one third of these had already received fatal injuries inside the car. In our series, most of those ejected (64%) were ejected through open doors. Of the rest, 15% were ejected through open convertible roofs; 10%, through windshields; 6%, through side windows; and 4%, through a roof that had been ripped off. The specifics of the occupant's position before ejection, and the portals of egress are given in Table 6.

Many envision ejection as occuring by failure of the door-latch mechanism alone, but there are other aspects just as important. For example, Gross, at the Institute of Transportation and Traffic Engineering, University of California at Los Angeles, has shown that doors can be opened by latch failure caused by impact of another car directly against the door, or impact from the car body adjacent to the latch mechanism; by a seat ramming the opposite door; by bending of the vehicle in a horizontal plane; and by contact of the outside handle push button with the ground in roll-over accidents; as well as by numerous other mechanisms.[15] Gross has further shown that a seat or occupant striking the door can generate more than 2,000 lb of force which can cause a door to open. Likewise, bending of the remote rod of the latch from direct impact with the door can cause the door to open.

Ejection through the windshield, through an open convertible top, or through a side window occurred less often. All those ejected through open convertible tops were in roll-over accidents. Specifics as to each ejection fatality, including photographs and capsule descriptions, have been presented previously.[14]

In order to keep the doors closed to prevent ejection of the occupant, the latch-striker mechanism must be as strong as required, but it is equally important that the occupants and seats which strike the door from within be more adequately secured. Parenthetically, it must be added that the integral strength of the door latch and striker in American cars has been increased in recent years. Since the completion of this project, investigated accidents involving recent-model cars have shown that instead of door and latch-striker separation, more and more cases have been seen in which the latch-striker inner lock is stronger than the attachments of these components to the door or pillar, and either the latch or the striker is ripped from its mounting under severe loading conditions. However, no ejections have been noted in

Table 3.--Ages of Drivers at Fault in Fatal Automobile Accidents

Age (yr)	No.
Under 20	21
20-25	33
25-30	17
30-35	11
35-40	16
40-45	9
45-50	8
50-55	5
55-60	5
60-65	8
65-70	3
70-75	2
Unknown	1
Total	139

Table 4.--Drinking of Driver at Fault Before Fatal Accident

Alcohol Status of Driver	No.*	%
Had been drinking	69	50
Had not been drinking	36	26
Unknown	34	24
Totals	139	100

*In 34 of these 69 cases, the driver of the at-fault car survived or no autopsy was performed; hence the alcohol content was not determined, but all these drivers are known to have been drinking.

Table 5.--Number of Fatalities by Seat Location and Injury-Producing Agent

Cause of Fatality	Occupant's Position: Driver	Front Right	Front Center	Rear Right	Rear Center	Rear Left	Total
Ejection	28*	11	4	3	6	2	48
Front door	17	13	-	-	-	1	31
Steering assembly†	28	-	1#	-	-	-	29
Instrument panel	9	13	1	-	1	-	24
Rear door or panel	-	-	-	7	4	3	14
Roof	8	2	-	-	-	-	10
Header	3	3+	2+	-	-	-	8
A-pillar	5	1	-	-	-	-	6
Other‡	3						3
Back of front seat	-	-	-	-	-	1	1
Windshield	-	1	-	-	-	-	1
Unknown	-	1	-	-	-	-	1
Totals	101	45	8	10	6	7	177

*Four ejected drivers were pinned beneath their cars; all died from suffocation.
†Ten drivers received their fatal injuries from the steering wheel; the others (18), from the end of the steering column.
#Gear-shift lever.
+One passenger was killed by impact with the sun-visor support.
‡Board through vent window; hood through windshield; one driver struck his head on the floor behind the passenger's seat.

Table 6.--Ejected Passengers and Mode of Ejection

Portal of Egress	Occupant's Position: Driver	Right Front	Center Front	Right Rear	Left Rear	Total
Left front door	15	-	-	-	1	16
Right front door	4	9	2	-	-	15
Open convertible roof	2	1	1	2	1	7
Windshield	4	-	1	-	-	5
Side window	2	1	-	-	-	3
Ripped-off roof	1	-	-	1	-	2
Totals	28	11	4	3	2	48

these cases. Especially in roll-over accidents, the doors can be opened by the outer door striking the road surface or debris along the road edge or in the off-road area. Only by locking the doors from inside, an overt and purposeful act on the part of the occupant, can this type of door-opening mechanism be prevented.

Ejection through the windshield, through the open convertible roof, or through the side window will not occur if the occupants are restrained by seat belts, or better yet by seat-belt, shoulder-belt combinations. The Accident Crash Injury Research group of Cornell University showed some ten years ago that the occupant has a better chance of survival if he is kept in the car rather than ejected.[16] We postulate that of the 48 persons ejected from cars in this study, 38 would have survived by the use of the seat belt alone and that three others would have survived with the seat-belt, shoulder-belt combination (Table 7). Thus, if occupants can be kept in the car by improvements in the door latch system, as well as by the use of restraint systems and the purposeful act of locking the doors from the inside, a significant number of individuals could be saved each year.

The idea advocated by some individuals, that of having a "pop-out" windshield so that occupants (almost always unbelted) would not sustain facial lacerations or serious head injuries, is one to which we do not subscribe. If this entire area is open to unrestrained occupants, the chances of ejection are increased, especially in head-on collisions and in accidents in which the vehicle spins after impact. With ejection the leading cause of death, and windshield impacts only a minor cause, why then increase the chances of ejection? With the new laminated safety glass in the windshields of all American-made cars, beginning with the 1966 models, we feel that it is better for the unbelted occupant to strike this glass than to go out through the open windshield area. In the fatality series, 10% of those fatally injured as a result of ejection were ejected through the windshield after the glass broke due to frame deformation, usually in roll-over accidents.

Those few ejected passengers (four out of 48) who would not have survived even by the use of a seat-belt, shoulder-belt combination were in accidents in which there was a marked collapse and compromise of the passenger compartment.

Among the passengers ejected, the fatal injury was inflicted to the head more often than to any other area of the body (Table 8). Fatal injuries of only the head were found in 31% of the passengers ejected; fatal injuries of both the head and another area of the body were found in 33% of the victims of ejection. Most of the injuries to the head were caused by the victim striking some structure outside the car, not by being struck by the vehicle itself. Thoracic injuries, found in 50% of the victims, were due to crushing, usually from the car rolling over the victim, or by striking or being struck by another vehicle.

Front-Door or Rear-Panel (Door) Impacts.--The second most common agent producing fatal injury was the front door (18%). When this percentage is combined with that of death from impact to the rear door or panel, 25% of the victims received their fatal injuries from impacts to the side structures of the occupants' compartment. In these cases, the passenger compartment collapsed because of a side impact in a collision at an intersection or when the vehicle slid broadside into an immovable object such as a tree, guardrail, or bridge pillar. These types of impacts caused the door to collapse inward. Almost all of those killed by door impacts were sitting on the side of impact.

In general, most occupants did not die from striking the doors but rather from the side structures collapsing inward on them. The areas of the body with fatal injuries from such impacts are shown in Table 9. The head, either as a single area fatally injured, or in combination with other areas, was injured most often in 22 of the 45 deaths from side impacts. In 15 cases, the thorax also sustained fatal injuries. It is postulated that seat belts could have prevented only six of the 45 deaths from door or rear-panel impacts. Only one individual probably would not have been killed if a seat belt-shoulder belt had been used. An additional five occupants probably could have survived if maximum restraint systems, the seat belt-double shoulder belts, were used. In these latter cases the impact was to the opposite side of the car, and it is believed that the occupant would have needed a double shoulder belt to prevent his striking the inward-bending structures of the car. The majority of door impacts were to the side on which the occupant was seated, and collapse and compromise of the safety of the passenger in the cabin structure precluded survival even if a maximum restraint system had been used. In the series of 45 fatalities from side impacts, three individuals wearing seat belts died from impacts to their side of the car; in two of these collisions the fatality car was struck by a truck; and in the other case the car slid broadside into a tree. The majority of these victims (31 of 45) would not have been saved even if maximum restraint systems had been used, again because the cabin area collapsed, usually on the side where the victims were seated in the vehicle.

Steering Assembly Impacts.--Ranking third in frequency are those deaths resulting from striking the steering assembly. This object was the cause of death in 16% of the cases in our series; all but one involved the drivers. Drivers' deaths from steering-assembly impacts

Table 7.--Survivability Potential of Restraints in Ejection Deaths

Occupant's Position	Restraints: Seat Belts	Seat Belts With Shoulder Belts	Not Saved	Unknown	Total
Driver	25	1	1	1	28
Front right	7	2	-	2	11
Front center	2	-	2	-	4
Rear right	2	-	1	-	3
Rear left	2	-	-	-	2
Totals	38	3	4	3	48

Table 8.--Body Areas Injured in Ejection Deaths

Body	Driver	Front Right	Front Center	Rear Right	Rear Left	Total
Head	7	5	1	2	-	15
Neck	3	1	-	-	-	4
Thorax	5*	1	1	-	-	7
Lower extremity	-	-	-	-	1	1
Head, neck	1	-	-	1	-	2
Head, thorax	7	1	-	-	1	9
Head, abdomen	-	1	-	-	-	1
Head, thorax, abdomen	2	2	-	-	-	4
Thorax, abdomen	3	-	1	-	-	4
Abdomen, pelvis	-	-	1	-	-	1
Totals	28	11	4	3	2	48

*Four individuals in this category died of suffocation; they were pinned beneath the car.

Table 9.--Body Areas With Fatal Injuries From Impacts With Door or Rear Panel

Body Areas	Driver	Front Right	Rear Right	Rear Center	Rear Left	Total
Head	-	4	3	3	1	11
Neck	1	-	-	-	-	1
Thorax	3	2	-	-	1	6
Head, thorax	6	3	1	-	-	10
Thorax, abdomen	4	2	2	1	2	11
Neck, thorax	2	1	-	-	-	3
Head, thorax, abdomen	1	1	-	-	-	2
Head, pelvis						
Lower extremity	-	-	1	-	-	1
Totals	17	13	7	4	4	45

Table 10.--Survivability Potential of Restraints in Deaths From Steering-Assembly Impacts

Occupant's Position	Seat Belt	Seat Belt With Shoulder Belts	Seat Belt With Double Shoulder Belt	Not Saved	Total
Driver	4	8	2	14	28
Front center*	1	-	-	-	1
Totals	5	8	2	14	29

*Gear-shift lever.

occurred as often as death by ejection (30% each). The steering assembly includes not only the steering wheel but also the end of the steering column and the gear-shift lever. Steering assemblies were found to cause deaths in several ways: (1) The steering column and wheel remained in position and did not move rearward into the passenger compartment. The occupant struck the wheel (with or without noticeable deformation of the steering wheel) and sustained fatal internal injuries. (2) The occupant struck the steering wheel with enough force to collapse it, thus exposing the end of the steering column which then was the injury-producing agent. (3) The steering column penetrated the cabin area. This is usually associated with deformation of the steering wheel from the occupant's impact. In some of these cases, collapse and rearward displacement of the forward compartment structures were partially responsible for the rearward movement of the steering column.

In ten of the 29 deaths from steering-assembly impacts, the occupants, usually the driver, received their fatal injuries from the steering wheel; 18 died by striking the end of the steering column. In one case, a child sitting on the lap of the front-seat passenger struck a gear-shift lever. Of the 28 drivers who died from impacts with the steering assembly, 14 could not have survived even if maximum restraint systems had been used (Table 10). In these high-speed-collision cases, the steering column had penetrated the cabin and was associated with rearward displacement of the forward cabin structures (11 deaths). However, in the other 14 deaths no rearward displacement of the forward cabin structures was noted; and there was little or no penetration of the steering column into the cabin. In all of the 14 nonsurvivable steering-assembly impacts there was steering column penetration into the cabin. However, in 11 of these 14 cases there was rearward collapse of forward cabin structures along with penetration by the column. In some of the deaths from steering-assembly impacts, the front seat moved forward on its tracks, and added to the force of the individual moving forward. With more securely mounted seats, it is possible that a few of these deaths would not have occurred.

Probably only five of the 29 victims could have survived if only a seat belt were used, and eight more could have survived by the use of a seat-belt, shoulder-belt restraint system. In those collisions where the driver struck the steering assembly and the guest passenger struck the instrument panel, both were killed in five cases, and in seven cases the passengers died and the drivers survived. We believe that the new collapsible steering column, now standard on many of the 1967-model cars, would have reduced significantly the number of driver fatalities from steering-assembly impacts. Fatal injuries from steering-assembly impacts were found more often in the thorax or thoracic and abdominal areas than in any other region of the body (Table 11). As the individual moves forward to strike the steering wheel and column, the thorax and abdomen are the primary target areas; and they receive the full brunt of the forces of the impact.

Table 11.--Fatal Injuries From Steering-Assembly Impacts

Body Areas	Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Not Saved	Total
Head	1*	-	-	2	3
Neck	-	-	1	1	2
Thorax	1	4	-	3	8
Abdomen	3	1	-	-	4
Head, thorax	-	1	-	3	4
Thorax, abdomen	-	2	1	4	7
Head, thorax, abdomen	-	-	-	1	1
Totals	5	8	2	14	29

*Passenger occupying center of the front seat impacted gear-shift lever.

Table 12.--Survivability Potential of Restraints in Deaths From Instrument-Panel Impacts

Occupant's Position	Restraint Systems: Seat Belts	Seat Belts With Shoulder Belts	Seat Belts With Double Shoulder Belts	Not Saved*	Total
Driver	2	3	2	2	9
Front right	6	3	1	3	13
Front center	-	1	-	-	1
Rear center	1	-	-	-	1
Totals	9	7	3	5	24

*In all of these cases there was forward collapse of the cabin area onto the victim.

Table 13.--Body Areas With Fatal Injuries in Deaths From Instrument-Panel Impacts

Body Areas	Occupant's Position: Driver	Front Right	Front Center	Rear Center	Total
Head	4	2	-	1	7
Thorax	1	2	1	-	4
Abdomen	-	1	-	-	1
Head, thorax	1	1	-	-	2
Head, abdomen	1	1	-	-	2
Neck, thorax	-	1	-	1	1
Thorax, abdomen	2	2	-	-	4
Head, neck, thorax, abdomen	-	2	-	-	2
Pelvis	-	1	-	-	1
Totals	9	13	1	1	24

Instrument Panel Impacts.--Stiking the instrument panel caused 24 deaths (13%). Either the occupants struck the panel, or the front of the passenger compartment collapsed displacing the panel rearward, toward or onto the occupant. Instrument-panel impacts are one of the leading causes of death for front-seat passengers. Fourteen victims were front-seat passengers, nine were drivers, and one was a rear-seat occupant. This usually occurred in high-speed, head-on impacts with a tree or other cars. Survival was precluded by invasion of the passenger compartment. The survivability potential of restraint systems is shown in Table 12. Of the 24 occupants killed by instrument-panel impacts, five would not have survived even if a seat belt with a double shoulder belt had been used. These deaths were due to rearward displacement of the instrument panel due either to a relatively high-velocity impact with a large tree (two cases), or to off-center, forward-force impacts with other cars (three cases). This rearward displacement of the instrument panel precluded survival by the invasion and compromise of the passenger compartment. In three cases, a seat belt, double shoulder belt would have been needed for survival. In these cases, there was partial rearward collapse of the instrument panel, and in order not to contact the panel, the double restraint to the upper part of the torso would have been needed. In six cases, a seat-belt, shoulder-belt restraint would have been needed for survival. In one case, a knob perforated the head of a 14-year-old girl. This head-on, car-tree impact caused the center of the instrument panel to buckle upward, and exposed the semirecessed radio knob. The upper part of the instrument panel was padded. In two cases, the drivers struck the center of the instrument panel. A restraint to the upper part of the torso would have prevented their impacting this area of a partially rearward-displaced panel. In another case, a driver wearing a seat belt flexed slightly to the right and struck the right margin of the instrument panel over the instrument cluster. An unbelted passenger in the center of the front seat struck an unpadded instrument panel, and a restraint to the upper part of the torso would have been needed for survival. In this case, both the driver and the passenger in the front seat on the right side survived.

Fatal injuries sustained in instrument-panel impacts were frequently found in the head more often than in any other area of the body; however, the fatal injuries noted in the thorax or abdomen or both were also relatively high in frequency (Table 13).

In some head-on collisions at high speed, or frequently at lower speeds when trees were struck, the face of the instrument panel rotated upward. The significance of this event should not be underestimated for recessed knobs and controls could be struck even by an occupant wearing a seat belt if this rotation should occur. Therefore, the need to eliminate this rotation is obvious as is the need for occupants to use both seat belts and shoulder belts.

Recontouring and padding of the panel would probably have prevented two fatalities of occupants not wearing seat belts, and possibly five other victims might also have survived. In general, the design of the instrument panel is extremely important for the occupant wearing a seat belt, for the severity of injuries can be decreased by force-dissipating materials and redesign of known impact areas. Since it is hoped that more and more people will be wearing seat belts, the area of possible impact, "the strike zone," will need to be studied in depth to prevent head injuries caused as the occupants flex over their belts. This injury, however, can easily be prevented by the use of shoulder restraints along with the seat belt.

Roof Impacts.--Impacts against the roof and supporting pillars produced 14% of the fatalities. Ten occupants died by striking the roof, six by hitting the A-pillar alongside the windshield, and eight others by striking the front part of the roof over the windshield (the header). The roof of the car collapsed onto eight of the ten passengers who struck it. Two deaths from impact with the roof occurred without deformation of the roof; the occupant not wearing a seat belt moved upward into the area over the passenger seat.

All eight of the victims who struck the header area were unrestrained as were the six victims from impact with the A-pillar. There is no doubt that the use of energy-absorbing materials in these areas might have prevented some of the deaths of even unrestrained occupants. However, such padding must be done with caution lest the driver's field of view be restricted. In cases in which the roof collapsed onto the occupant, the question of strength of the roof is all important. In most of our cases, the roof collapsed directly over the driver's head from an impact with a tree. In others, the A-pillars and the front of the roof collapsed onto the occupants; thus the placement of a roll bar behind the driver, crosswise at the middle of the roof, would have been of benefit in only one of the roof impacts. Strengthening of the A-pillars might be a solution in some roof-collapse cases, but combining this with adequate padding of the A-pillars might violate the driver's visual area.

We postulate that ten of the 24 victims from roof-and-supporting-structure impact would have survived had they used a lap seat belt alone and others would have survived with the seat-belt, shoulder-belt combination (two each) (Table 14). The fatal injuries from impact with the roof and supporting structures are primarily concentrated about the head as would be expected (Table 15). In 14 of the 24 cases the head alone was the only area of the body injured.

Survival With Seat Belts

"Could they have survived had they not been ejected from the car or projected into structures within the car?" We asked ourselves this question when reconstructing each accident. As seen in Table 16, we

Table 14.--Survivability of Victims Impacting Roof and Supporting Structures if Restraints Had Been Used

Objects Producing Fatalities	Restraints: Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Not Saved	Total
Roof	2	-	-	8	10
Header	4	2	-	2	8
A-pillar	4	-	2	-	6
Totals	10	2	2	10	24

Table 15.--Fatal Injuries From Impacts With Roof and Supporting Structures

Objects Producing Fatalities	Neck	Neck	Head, Neck	Head, Thorax	Head, Thorax, Abdomen	Head, Neck, Thorax, Abdomen	Total
Roof	4	1	1	1	2	1	10
Header	7	1	-	-	-	-	8
A-pillar	3	1	-	2	-	-	6
Totals	14	3	1	3	2	1	24

Table 16.--Passenger Position and Probable Survivability With Restraints

Decedent's Position in Car	Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Not Saved	Unknown	Total
Driver	41	15	7	36	2	101
Center front	4	1	-	3	-	8
Right front	16	6	3	18	2	45
Right rear	2	1	1	6	-	10
Center rear	4	-	1	1	-	6
Left rear	4	-	-	2	1	7
Totals	71(40%)	23(13%)	12(7%)	66(37%)	5(3%)	177

postulate that 40% of the fatalities could have been prevented if a seat belt had been worn. This figure includes all accidents, irrespective of the point of impact of the car (front, side, or rollover), where the victim was seated at the time of the impact (driver, passenger, or rear-seat occupant), the make or model of the vehicle, the type of vehicle that struck the car, the object that the car struck, or the vehicle's speed at impact. It is further postulated that an additional 13% of the victims could have been saved had a seat belt and shoulder belt been worn, and 7% more could have been saved if a double shoulder-belt had been used with a seat belt.

The majority of the deaths produced by ejection could have been prevented by the use of a lap seatbelt (Table 17). In deaths from impacts with the steering assembly, door, or roof, 50% or less could have survived even if double shoulder-belts had been used with the seat belts.

Of the front-seat passengers who were killed by striking various objects, or by ejection, the majority in each group could have survived by the use of only the seat belt (Table 18). However, door impacts were such that almost all passengers could not have survived because of collapse and compromise of the cabin area. This is also true for all other occupants of the vehicle.

Eleven of the 23 deaths of rear-seat occupants could have been prevented by seat belts (Table 19). Of those who could not have survived, the majority was struck by the inbending side or door. The occupants killed were usually sitting on the side of the impact.

Seat-Belt Education

It is imperative, therefore, that much more emphasis be placed on educating the American public as to the value of wearing seat belts and shoulder belts. This area has only been lightly touched upon and much more work must be done by federal and other national organizations, through the press and television, and by the automobile manufacturers.

One always hears about the case where an individual was ejected from a car and had he stayed in the car he would have been killed, or about the individual who was killed wearing a seat belt and someone says he would have survived had he not worn the belt. Statistically these cases are rare. Therefore, it must be stressed that this is not a common occurrence and that chances of survival are greater if a seat belt is worn. Now that shoulder belts are standard equipment on the new-model cars, this item needs to be strongly emphasized as a safety feature that should prevent fatal injuries and reduce the seriousness of any injuries that may be sustained by flexing over a seat belt. Thus, a broad-scale national campaign must be instituted, with all available means, to better inform the American public of the need for this usage. In addition, we feel it is imperative that the parents of small children be educated as to the use of restraint systems for children.

Table 17.--Probable Survivability of Drivers With Restraints

Cause of Fatality	Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Not Saved	Unknown	Total
Ejection	25	1	-	1	1	28
Steering-assembly impact	4	8	2	14*	-	28
Door impact	2	-	2#	12	1	17
Roof impact	2	-	-	6	-	8
Instrument panel impact	2	3	2+	2	-	9
A-pillar impact	4	-	1	-	-	5
Header impact	1	2	-	-	-	3
Other	1	1	-	1	-	3
Totals	41	15	7	36	2	101

*In 11 of the 14 steering-assembly deaths there was front-end collapse of the driver's compartment.
#In both cases the right door collapsed, but did not compromise the safety of the driver's compartment.
+In one case there was a collapse of the cabin area.

Table 18.--Probable Survivability of Right-Front Passenger With Restraints

Cause of Fatality	Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Saved	Unknown	Total
Ejection	7	2	-	-	2	11
Instrument-panel impact	6	3	1	3	-	13
Door impact	1	-	1	11	-	13
Roof impact	-	-	-	2	-	2
Header impact	2	-	-	1	-	3
A-pillar impact	-	-	1	-	-	1
Windshield impact	-	1	-	-	-	1
Unknown	-	-	-	1	-	1
Totals	16	6	3	18	2	45

Table 19.--Probable Survivability of Rear Occupants

Cause of Fatality	Seat Belt	Seat Belt With Shoulder Belt	Seat Belt With Double Shoulder Belt	Not Saved	Total
Inbending side or door	3	-	1	8	12
Ejection	5	-	-	1	6
Instrument-panel impact	1	-	-	-	1
Windshield impact	1	-	-	-	1
Back, front-seat impact	1	-	-	-	1
Unknown	-	1	1	-	2
Totals	11	1	2	9	23

By the use of restraint systems, a significant number of deaths in automobiles can be prevented. Additional lives can be saved by structural and design modifications of the vehicle, the easiest of the three factors to modify when one considers the difficulty in modifying human behavior and the impracticability of changing all existing roadways. However, it is doubtful that much progress can be made by redesign alone, as long as the occupants are free to move about in the car during a collision. The cooperation of every automobile occupant in wearing a seat belt and shoulder belt is needed in order to take full advantage of the available in-car safety features. This need for cooperation cannot be overemphasized.

No single panacea will be found to reduce traffic mortality and morbidity. The need for safety features and improved design in the automobile is obvious; but also needed, is a concentrated effort to educate the occupants to use seat belts, serious effort for safer highway and off-roadway designs, and adequate legislation and enforcement to help prevent the first collision.

The physician's responsibility in this educational effort must not be taken lightly. Since this is a major public health problem, physicians must be conversant on all aspects of the traffic-safety problem. Generally speaking, physicians have little knowledge concerning the depth of the problem; as does the general public, they have pet theories and solutions. Traffic-safety education of the physician is a necessity following which proper instruction of the patient can have a marked effect toward the reduction of morbidity and mortality on our highways.

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References

1. Huelke, D. F., and Gikas, P. W.: "Automobile Safety in the Medical Curriculum," in Sixth Stapp Conference-Proceedings, Minneapolis: University of Minnesota Press, 1962, pp. 73-75.

2. Huelke, D. F.; Gikas, P. W.; and Hendrix, R. C.: "Patterns of Injury in Automobile Accidents: A Review of 231 Autopsy Cases," in Sixth Stapp Conference-Proceedings, Minneapolis: University of Minnesota Press, 1962, pp. 44-58.

3. Gikas, P. W., and Huelke, R. F.: Causes of Death in Automobile Accidents: Can Seat Belts Really Save Lives? J Mich Med Soc 63:351-354 (May) 1964.

4. Huelke, D. F.; Grabb, W. C.; and Gikas, P. W.: "Injuries and Deaths From Windshield and Instrument Panel Impacts," in L. M. Patrick (ed.): Eighth Stapp Car Crash Conference-Proceedings, Detroit: Wayne State University Press, 1966, pp. 167-184.

5. Huelke, D. F.; Grabb, W. C.; and Dingman, R. O.: Facial Injuries in Automobile Accidents, Proc Amer Assoc Auto Med, Oct 1964, pp. 65-66.

6. Huelke, D. F., and Gikas, P. W.: How Do They Die? Medical-Engineering Data From On-Scene Fatal Automobile Accidents, SAE Trans 74:212-216 (Feb) 1966.

7. Huelke, D. F., and Gikas, P. W.: "Investigations of Fatal and Non-Fatal Automobile Accidents," in J. Martin (ed): Transactions of the 19th Annual Convention of the American Trial Lawyers Association, Cincinnati: W. H. Anderson Co., 1965, pp. 396-403.

8. Gikas, P. W., and Huelke, D. F.: "Pathogenesis of Fatal Injuries to Rear Seat Occupants of Automobiles," in M. K. Cragun (ed.): Ninth Stapp Car Crash Conference-Proceedings, Minneapolis: University of Minnesota Press, 1966, pp. 355-361.

9. Huelke, D. F.: "Federal and State Standards for Automotive Design," in M. K. Cragun (ed.): Ninth Stapp Car Crash Conference-Proceedings, Minneapolis: University of Minnesota Press, 1966, pp. 430-432.

10. Huelke, D. F., and Gikas, P. W.: "Determination of Seat Belt Effectiveness for Survival in Fatal Highway Collisions," in D. M. Severy (ed.): Tenth Stapp Car Crash Conference-Proceedings, Springfield, Ill: Charles C Thomas, Publisher, 1965, pp. 403-431.

11. Huelke, D. F., and Gikas, P. W.: Non-Intersectional Automobile Fatalities: A Problem in Roadsign Design, in Highway Res Record 152: 103-119 (Jan) 1966.

12. Huelke, D. F.; Grabb, W. C.; and Dingman, R. O: Facial Injuries Due to Windshield Impacts in Automobile Accidents, Plast Reconstr Surg 37:324-333 (April) 1966.

13. Huelke, D. F., and Gikas, P. W.: Investigation of Fatal Automobile Accidents From the Forensic Point of View, J Forensic Sci 11:474-484 (Oct) 1966.

14. Huelke, D. F., and Gikas, P. W.: "Ejection: The Leading Cause of Death in Automobile Accidents," in Tenth Stapp Car Crash Conference-Proceedings, New York: Society of Automotive Engineers, Inc., 1966, pp. 260-294.

15. Gross, A. G.: Accidental Motorist Ejection and Door Latching Systems, read before the Society of Automotive Engineers Congress, Detroit, Jan 1964.

16. Tourin, B.: Ejection and Automobile Fatalities, Public Health Rep 73:381-391 (May) 1958.

SEATBELT LAWS: PROS AND CONS

OBJECTIVE: Explain the pros and cons of passing laws to alter social practices that have been proven to be scientifically inadvisable.

THE EFFECTS OF SEAT BELT LEGISLATION: THE SASKATCHEWAN EXPERIENCE*

Carl Shiels

Introduction

On July 1, 1977, Saskatchewan became the third province in Canada to proclaim legislation requiring motorists to use available seat belts. Ontario had lead the way on January 1 of 1976, followed 6 months later by Quebec. On September 1, 1977 British Columbia followed suit. More than 80% of Canadians are now "living" with seat belt use laws.

Although the effects of seat belt legislation have been documented to various extents in several countries, attempts to measure effectiveness in Ontario and Quebec have been clouded, at least in the minds of anti-seat belt lobbyists, by the coincidental introduction of other countermeasures, most notably a reduction in speed limits on major highways from 65 mph to 55 mph.

In Saskatchewan, seat belt legislation was part of a package of new safety initiatives introduced in 1977. This package included a comprehensive traffic safety curriculum for the schools, an experimental traffic safety court in Regina, expansion of Driving Without Impairment courses to include more communities in the province, introduction of roadside breath testing of impaired drivers and a municipal grants program for road safety improvements. However, none of these programs are as yet sufficiently well advanced to produce a significant improvement in the traffic injury and fatality toll.

During 1977 the conversion of the province's speed limits to metric saw a slight decrease in most limits. The maximum reduction resulted when 65 mph limits were converted to 100 km/h. However, according to speed studies carried out by Saskatchewan Department of Highways and Transportation, even this modest 4.6 km/h (3 mph) reduction has not been reflected in the average travelling speed on the province's highways.

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*Carl Shiels, "The Effects of Seat Belt Legislation: The Saskatchewan Experience." Paper presented to: the 10th Annual Safety Conference, Canada Safety Council (October, 1978). Reprinted with permission.

It is, therefore, suggested that the injury and fatality statistics, which have been recorded during the first year of the Saskatchewan belt law, largely reflect the influence of increased seat belt use.

. . .

About the Law

The Saskatchewan seat belt law applies only to front seat occupants who are over the age of 5 years or who weigh 50 pounds or more and who occupy seating positions for which the vehicle manufacturer provided a seat belt.

In vehicles where separate or detachable shoulder harnesses have been installed, only the lap belt must be worn. Exemptions have been provided for persons with medical certificates signed by a physician, for certain delivery personnel and for persons travelling in reverse.

By regulation, exemptions have also been provided for police officers when transporting a prisoner and where no mechanism is provided for the protection of the driver, for cab drivers while accompanied by a fare and for driving instructors and examiners who, while accompanying a student driver, may be required to take control of the vehicle.

. . .

Enforcement

Although the law was proclaimed July 1, 1977 police were advised that no tickets should be issued before October 1, 1977. This approach was adopted to provide time for the motoring public to get their belts in order and to develop the habit of using them. During this three month period, police were encouraged to issue warnings, distribute informational materials and help to explain the use and function of belt systems.

Starting on October 1, police were asked to begin enforcement. However, crackdowns and enforcement blitzes were discouraged. Instead, "failure to wear" tickets were to be issued in conjunction with routine police activities.

Table I shows the enforcement levels during the first ten months after enforcement began. Based on these figures an annual enforcement rate of 8.7 tickets per 1000 drivers has been achieved.

TABLE I

Number of Seat Belt Tickets Issued During First 10 Months of Enforcement

Month	Tickets
October '77	393
November '77	238
December '77	327
January '78	474
February '78	413
March '78	691
April '78	618
May '78	361
June '78	258
July '78	202

12.9% of tickets go to passengers.

Public Opinion

Four Gallup type polls were carried out by an independent survey service to monitor public reaction to the law. Samples of approximately 1000 persons were involved. The surveys took place during April 1977, November 1977, April 1978 and August 1978. Results are listed in Table II.

Although the results of the April 1977 survey indicated majority support for legislation (54.3%), it was not overwhelming. Persons who were undecided accounted for 7.8% of the sample.

There were substantial differences among demographic groups. For example, strong support was indicated by professionals, persons with university education and by the 18-29 age groups.

TABLE II

PUBLIC OPINION OF SEAT BELT LEGISLATION

*(Total Sample Size)

	APRIL '77 (1033)*			NOVEMBER '77 (1008)*			APRIL '78 (1041)*			AUGUST '78 (1024)*		
	FAV.	OP.	NO. OP.	FAV.	OP.	NO. OP.	FAV.	OP.	NO. OP.	FAV.	OP.	NO. OP.
BY SEX												
Male	49.7	42.3	8.0	53.3	43.7	3.0	63.0	34.5	2.5	71.9	24.5	3.5
Female	59.1	33.3	7.7	69.1	27.3	3.6	66.7	30.6	2.7	78.6	18.7	2.7
BY EDUCATION												
Less than High School	39.6	49.0	11.4	43.5	48.7	7.7	57.2	39.1	3.8	71.5	24.9	3.6
Some High School	51.1	40.5	8.3	59.6	38.6	1.8	62.6	34.2	3.2	70.5	26.3	3.2
High School Grad	61.7	32.4	5.9	67.1	31.0	2.0	65.7	33.3	1.0	76.7	19.7	3.6
Some Coll./Univ.	71.0	24.3	4.7	74.5	23.4	2.1	80.1	18.0	1.9	84.0	14.4	1.7
BY AGE												
18 - 29	61.7	34.0	4.3	65.6	32.4	2.0	66.0	32.6	1.4	74.8	23.4	1.8
30 - 44	57.1	36.0	6.9	64.1	34.8	1.1	67.7	31.1	1.2	80.1	18.1	1.8
45 - 54	42.2	48.1	9.6	56.7	38.7	4.7	65.0	32.6	2.4	72.8	23.1	4.1
55 plus	51.7	37.3	11.0	52.9	40.9	6.2	62.1	33.1	4.8	70.8	23.6	5.5
BY INCOME												
Under $10M	47.0	43.9	9.1	50.2	42.2	7.6	62.0	33.1	4.8	68.5	26.5	5.0
$10M to $14.9M	57.7	34.7	7.5	61.9	37.7	0.5	66.4	31.5	2.1	76.0	22.4	1.6
$15M to $19.9M	61.1	35.4	3.5	68.4	28.7	2.9	69.4	29.5	1.2	71.8	25.4	2.8
$20M and Over	61.4	33.7	4.8	64.1	34.3	1.6	66.9	32.0	1.0	77.7	20.6	1.6
BY OCCUPATION												
Prof. Exec.	70.3	24.1	5.5	70.8	26.5	2.7	75.9	23.5	0.6	78.9	18.3	2.8
Sales/Cler.	59.8	34.3	5.9	62.5	35.7	1.8	66.6	32.6	0.8	84.4	11.5	4.1
Labour	53.8	39.9	6.3	61.3	37.0	1.7	56.4	40.9	2.7	74.5	23.4	2.1
Farmer	44.6	45.3	10.1	55.3	42.7	1.9	67.2	31.3	1.5	68.9	28.3	2.8
Stud't./Retired	54.1	36.2	9.7	54.2	37.4	8.4	61.2	33.0	5.8	73.0	22.2	4.9
CITY SIZE												
Regina	59.3	31.4	9.3	65.1	32.6	2.3	61.3	36.1	2.6	79.7	16.5	3.8
Saskatoon	65.6	28.6	5.6	65.4	29.6	4.9	65.2	32.3	2.5	82.1	14.3	3.6
1M to 100M	51.0	43.6	5.4	58.9	35.1	6.1	63.4	33.7	2.9	77.4	19.5	3.1
Under 1M	50.1	40.5	9.4	58.0	40.4	1.6	66.8	30.7	2.5	69.6	27.7	2.7
TOTAL INTERVIEWED	54.3	37.9	7.8	60.6	36.1	3.3	64.9	32.5	2.6	75.1	21.8	3.1

QUESTION - Are you in favor or opposed to legislation which requires the wearing of seat belts in motor vehicles?

KEY - FAV. = yes, favor OP. = no, oppose NO. OP. = Don't Know/No Opinion

Strongest opposition was recorded for farmers, persons with less than high school education and for persons 45 to 54 years of age. After the legislation came into effect there began a noticable upward shift in favourability. Overall support had risen to 60.6% in November 1977, 64.9% in April 1978 and 75.1% in August 1978.

By August of 1978, the difference among various socioeconomic groups had diminished. However, lowest support continued to be recorded for small town and farm populations.

Seat Belt Usage

Belt usage in Saskatchewan was monitored by means of four roadside surveys carried out by the University of Saskatchewan, Transportation Centre. The first was part of a nation-wide survey conducted for Transport Canada. The Saskatchewan component was designed to provide a statistically representative sample of all major roads and highways in the province. A total of 4069 vehicles were checked at 43 sites throughout the province during the week of May 13 to 19, 1977.

The second survey was carried out for the Transportation Agency of Saskatchewan during the period July 15 to 17, 1977. This was a much smaller survey involving 649 vehicles at 10 indicator sites used during the May survey. It was timed to monitor the short-term reaction to seat belt law proclamation but with the generally well-known enforcement moratorium in effect.

This smaller survey was repeated during the period October 14 to 16, 1977 to correspond to the onset of enforcement. A total of 1008 vehicles were checked.

A fourth survey took place in May of 1978. This survey was a full repeat of the May 1977 survey plus several sites added to reflect usage rates on northern roads, in small urban centres and in the City of Regina. A total of 5852 vehicles were checked during the week of May 22-28.

The results of the four surveys are presented in Tables III A, B and C. Children under 5 are included in the data. If they were in an unapproved child seat they were recorded as being unrestrained. If they were properly secured in a child safety seat they were recorded as being restrained by lap and shoulder harness.

Clearly there has been a substantial increase in belt usage in the province. The proportion of front seat occupants using some type of restraint had risen to 60.2% in May of 1978 compared to 24% in May of 1977. The May 1977 usage rate probably had begun to reflect the fact that legislation had been passed, although it had not been proclaimed law. Small surveys of belt use prior to 1977 suggested that usage was probably less than 20% overall.

The increase in belt use recorded during October 1977 appears to have been short-lived, with overall usage falling to the July 1977 levels by May of 1978.

Compliance with the law was calculated by counting front seat occupants wearing either lap or lap plus shoulder belts and occupants who had no restraint available (Table IV). The May 1978 compliance rate was determined to be 64.6%. This was down from the 79.5% recorded in October of 1977 when enforcement began and was virtually identical to the July 1977 compliance rate.

According to the May 1978 survey, restraint use by rear seat passengers remained very low at 8.9%. When children under 5 years were isolated from the May 1978 survey data, only 14% were in approved child restraints.

TABLE III A

RESTRAINT USE BY FRONT SEAT OCCUPANTS

AVAILABLE	IN USE	MAY '77	JULY '77	OCT. '77	MAY '78
Lap & Shoulder					
	Lap & Shoulder	16.8%	36.9%	45.7%	37.3%
	Lap Only	3.5%	10.7%	10.0%	11.5%
	None	52.5%	23.7%	9.4%	23.2%
Lap Only					
	Lap Only	3.7%	13.5%	17.7%	11.4%
	None	18.2%	11.8%	11.1%	12.3%
None					
	None	5.3%	3.4%	6.1%	4.4%
Total		100.0%	100.0%	100.0%	100.0%

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TABLE III B

RESTRAINT USE BY DRIVERS

AVAILABLE	IN USE	MAY '77	JULY '77	OCT. '77	MAY '78
Lap & Shoulder					
	Lap & Shoulder	18.3%	38.8%	50.2%	41.8%
	Lap Only	4.2%	12.0%	10.1%	12.2%
	None	53.4%	23.5%	9.6%	22.2%
Lap Only					
	Lap Only	3.6%	12.7%	18.0%	11.3%
	None	17.1%	10.8%	8.4%	9.1%
None					
	None	3.4%	2.2%	3.7%	3.4%
Total		100.0%	100.0%	100.0%	100.0%

TABLE III C

RESTRAINT USE BY REAR SEAT PASSENGERS

AVAILABLE	IN USE	MAY '77	JULY '77	OCT. '77	MAY '78
Lap & Shoulder					
	Lap & Shoulder	3.2%	NOT SUFFICIENT DATA	NOT SUFFICIENT DATA	3.5%
	Lap Only	-			-
	None	0.4%			0.6%
Lap Only					
	Lap Only	7.8%			5.4%
	None	73.4%			77.2%
None					
	None	15.2%			13.2%
Total		100.0%			100.0%

TABLE IV

RATE OF SEAT BELT LAW COMPLIANCE

Month	Drivers	All Front Seat Occupants
May, 1977*	29.6%	29.3%
July, 1977	66.9%	64.6%
October, 1977	82.0%	79.5%
May, 1978	68.0%	66.7%

* Pre-Legislative Levels

OBJECTIVE: Explain the pros and cons of passing laws to alter social practices that have been proven to be scientifically inadvisable.

MYTHS ABOUT THE DANGERS OR DISPENSABILITY OF SEAT BELTS ARE NOT VALID*

U. S. Department of Transportation

A. MYTH: Seat belts are not needed for short trips made at moderate speeds.

FACT: Accidents occur at all speeds. In fact, the accident rate is lower on turnpikes and freeways than on city streets or rural roads.

"It is not uncommon to hear a car owner argue that he is a safe driver and rarely exceeds 30 mph and so does not require safety belts but this argument could only have merit if he could depend on other drivers not to crash into him. In Sweden, Lindgren and Warg (1962) have demonstrated that almost 90 percent of accidents which they studied happened at a speed below 30 mph while two-thirds of the injured received their injuries at this low speed including eight of 15 fatal cases. This flatly contradicts the popular belief that a speed below 30 mph is safe and shows that seat belts are as necessary at low as at high speed."

(Geoffrey J. Bourke, M. D., "The Efficacy of Car Safety Belts," Journal of the Irish Medical Association, October 1965, p. 114.)

"Nearly one-half of rural fatal accidents occur at speeds under 50 mph, based on reports from 3 states. Almost 50 percent of all rural accidents happens at speeds under 30 mph."

(National Safety Council, Accident Facts, 1971 Edition, Chicago: National Safety Council, 1971, p. 53.)

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*"Myths About the Dangers or Dispensability of Seat Belts are Not Valid," The Case for Seat Belts: Experimental and Statistical Evidence (Appendix 2), U. S. Department of Transportation, National Highway Traffic Safety Administration (U. S. Government Printing Office, January 1972). Reprinted with permission.

"Urban freeways are twice as safe as other city streets in terms of fatalities, and about four times safer as far as nonfatal injuries are concerned."

(F. C. Turner, Federal Highway Administrator. Remarks before the First General Session of the American Association of State Highway Officials 55th Annual Meeting, October 28, 1969, Washington, D. C.: Federal Highway Administration, 1969, p. 3.)

B. MYTH: Seat belts are likely to fail in the event of a serious crash.

FACT: If kept in good repair, it is estimated that seat belts will function adequately 99 percent of the time.

In a study made by Garrett and Braunstein of accidents involving 3,325 seat belt users, only 29, less than 1 percent, had their seat belts fail. Seat belt failure was usually associated with high speed and severe accidents.

(John W. Garrett and Paul W. Braunstein, "The Seat Belt Syndrome," Journal of Trauma, May 1962.)

C. MYTH: Belts trap automobile occupants in case of fire or submergence in water.

FACT: Less than 0.5 percent of all injury-producing accidents are followed by fire or submersion. In these cases, belted occupants are more likely to have less serious injuries than unbelted occupants and be better able to cope with the situation.

"The common prejudice against seat belts to the effect that they are the cause of people being burned up or drowned because of inability to get out of a flaming or sunken automobile is not founded in fact. Less than one-half of 1 percent of all serious accidents are followed by fire or submersion . . ."

(Marshall Houts, M. D., "Seat Belt Injuries," Journal of Trauma, February, 1970, p. 1.)

"Studies show that only 0.2 percent of injury-producing accidents are followed by fire and only 0.3 percent involve submersion. In any event the safety belt should make it possible for the occupant to cope better with these emergencies by virtue of a lesser degree of injury."

(Robert G. Frazier, M. D., "Hazards to Health: Effectiveness of Seat Belts in Preventing Motor-Vehicle Injuries," Journal of Trauma, February 1970, p. 29.)

Dr. R. D. Lister analyzed the injuries sustained by 837 drivers on front-seat passengers who were involved in accidents and who were wearing seat belts at the time of the accident. "In spite of the fact that the car overturned in 22 percent of the accidents, there was no reported case of the car catching fire, and no mention was made of any of the occupants having difficulty in getting out of his seat belt after the accident."

(R. D. Lister, M. D., and Barbara M. Milsom, "Car Seat Belts: An Analysis of the Injuries Sustained by Car Occupants," The Practitioner, 1963, p. 340.)

A study was made comparing the performance of 879 Volkswagen two-door sedan models with that of 26,673 American and imported cars involved in rural injury-producing accidents in 30 states.

"The frequency of fire among Volkswagens, after the accident took place, was among the lowest of all cars studied. The proportion of all cars that turned after an accident was less than 1 percent, ranging from 0.2 percent to 0.9 percent of the various car makes. For Volkswagen it was 0.4 percent. There was no indication that fires were associated with any specific accident type or vehicle group in terms of car size or engine placement.

The potential for fire might be expected to be greater for cars with the fuel tank in front because of the greater frequency of frontal impacts. However, the study showed, with respect to fire, that the performance of rear-engine cars, with the fuel tank in front, appeared to be better than that of front-engine cars."

(John W. Garrett and Arthur Stern, "A Study of Volkswagen Accidents in the United States," Journal of Safety Research, September 1969, p. 119.)

D. MYTH: Pregnant women should not wear seat belts.

FACT: Pregnant women are better off belted than unbelted. Shoulder harnesses should be worn with lap belts to prevent jackknifing.

Pregnant women are better off belted than unbelted. The greatest single cause of fetal death in accidents is the death of the mother. Of unbelted pregnant women who were ejected from cars by collision forces, 33 percent were killed and 40 percent seriously injured. Of the pregnant women who remained in the car, only 5 percent were killed and 11 percent seriously injured.

Pregnant women are more susceptible to injury by seat belts than are other people. Even so, pregnant women are better off belted than unbelted. Shoulder harnesses should be worn with the belts to prevent jackknifing.

(Dr. Warren Crosby and Dr. J. Paul Costiloe, University of Oklahoma School of Medicine. Study of 441 rural California accidents involving pregnant women. "Safety Ride for Mother and Child," Woman's Day, September 1971, p. 83.)

The Committee on Medical Aspects of Automotive Safety of the American Medical Association at its meeting in Chicago, February 3-4, 1967, considered the matter of wearing of seat belts by pregnant women, and developed the following statement:

> "It is the consensus of the Committee that a pregnant woman should definitely use an automobile seat belt the same as anyone else. The Committee believes that with such use, both the pregnant woman and the fetus are safer, provided the belt is worn as low on the pelvis as possible. The use of a shoulder strap in addition provides an extra safety factor."

E. MYTH: Seat belts are unsafe because they cause injuries in the event of crashes.

FACT: Cases in which seat belts have caused injuries have been reported in the medical journals, but such cases are rare. In most instances the injury attributable to the seat belt is not as great as the injuries which might have occurred without the belt.

In a study of 382 accidents, in no case was a belt responsible for causing a more severe injury than would have resulted had a belt not been worn.

(Stig Lingren, M. D. and Evert Wärg, "Seat Belts and Accident Prevention," The Practitioner, April 1972, p. 467.)

Automobile safety belts rarely cause intra-abdominal injury, especially if properly worn. Only 23 cases have been previously reported in the literature.

(J. R. LeMire, D. E. Earley and C. Hawley, "Intra-Abdominal Injuries Caused by Automobile Seat Belts," Journal of the American Medical Association, 1967, pp. 735-737.)

Following the LeMire-Earley-Hawley study in 1967, a series of 11 cases was reported at the Orange County Medical Center and Hoag Memorial Hospital in Newport Beach, California. Eight were major injuries and three minor injuries. There was one fatality which was due to a massive brain injury rather than the injury caused by the seat belt.

(Frank R. DiFiore, M. D., and Ock-Min Gin, M. D., "Injuries Due to Automobile Seat Belts," The American Surgeon, November 1968, pp. 828-830.)

Porter and Green reported two cases of injuries related to wearing the seat belt, but concluded:

> "Two main points should be stressed from the preceding discussion. First, a potential injury is inherent in the seat belts, and we should be aware of it. It is not a common injury and is an acceptable substitute for what can be speculated might occur if the victim had not been wearing a seat belt."

(Samuel D. Porter, M. D., and Edward W. Green, M. D., "Seat Belt Injuries," Arch Surgery, February 1968, pp. 242-246.)

Three cases in which some of the injuries caused by automobile crashes were attributable to seat belts were reported.

"It is clearly established that the use of seat belts is reducing the number of fatalities from automobile accidents. These three cases of intra-abdominal injury are presented not to detract from the value of seat belts, but to emphasize the significance of the sign of marked contusion and ecchymosis in the abdominal area, and to underline the need for maintaining a very high index of suspicion for intra-abdominal injuries. As high-speed travel and the use of seat belts increase, it may be that more intra-peritoneal injuries will be recognized, but this will be a small price to pay for the many lives saved and the more severe injuries prevented by the use of the seat belt."

(Kemp B. Doersch, M. D., and William E. Dozier, M. D., Department of Surgery, University of California School of Medicine, Davis, California, "The Seat Belt Syndrome," American Journal of Surgery, December 1968, pp. 831-833.)

Evidence indicates that automobile occupants are better off with seat belts than without. Seat belts present no hazard to occupants except possibly in unusual and isolated instances. From the accident and medical records drawn from a total of 2,778 automobiles in which at least one occupant was wearing a seat belt when an accident occurred:

- seven occupants received intra-abdominal injuries;
- seven occupants sustained pelvic fractures;
- injuries to the lumbar spine were noted in 12 cases;
- other minor cases of muscle strain or soreness in the abdominal regions or over the hip without accompanying injury to the internal organs or skeletal structures were noted.

(John W. Garrett and Paul W. Braunstein, "The Seat Belt Syndrome," Journal of Trauma, May 1962, p. 220. Reported in J. W. McRoberts, M. D., "Seat Belt Injuries and Legal Aspects," Trauma, February 1970, p. 7.)

"O'Brien in Melbourne (Australia) dealt with 153 consecutive cases of facial laceration sustained by the occupants of cars without seeing a single patient who had been disfigured whilst wearing a safety harness."

(Excerpt from "Safety Belts," The Lancet, March 26, 1966, p. 699. Referred to article by B. O. O'Brien in Medical Journal of Australia, 1965, p. 685.)

OBJECTIVE: Explain the pros and cons of passing laws to alter social practices that have been proven to be scientifically inadvisable.

HANSARD*

Saskatchewan Legislative Assembly

SECOND READINGS

HON. G. MacMURCHY (Minister of Municipal Affairs) moved second reading of Bill No. 104 - An Act to amend The Vehicles Act (No. 2)

He said: Mr. Speaker, I am pleased to introduce what is undoubtedly one of the major Bills of this Session. This legislation provides for the mandatory use of seat belts, under specified conditions and for several other safety related amendments to The Vehicles Act.

Under this Bill, Mr. Speaker, Saskatchewan will become the fourth province to pass a law requiring the wearing of seat belts. The Province of Ontario has had similar legislation in effect for more than one year. Quebec has a law in force, too, and in British Columbia a very tough seat belt law has received second reading.

This Act has one purpose to reduce the number of deaths and injuries caused by vehicle accidents. In an average year in Saskatchewan, Mr. Speaker, 300 people are killed, 10,000 more are injured in traffic accidents. There is a 50/50 chance that anyone will be involved in an accident in his lifetime and it is virtually certain that every family will have one of its members involved at some point.

Wearing a seat belt will not prevent an accident, but it is very likely to prevent death and injury resulting from accidents. In Ontario only one-twentieth of one per cent of drivers, who had accidents while wearing seat belts, were killed while there were four-tenths of one per cent of unbelted drivers who died. Among passengers only 9.6 per cent of those wearing seat belts were injured in contrast to nearly 14 per cent of unbelted persons who were hurt.

In short, then, the use of seat belts means an eight fold increase in the chances of surviving an accident and a 50 per cent increase in the likelihood of escaping uninjured. Translating these figures to Saskatchewan means we could prevent the death of 50 to 100 people every

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*Hansard. Saskatchewan Legislative Assembly, 1977. Reprinted with permission.

year and reduce the injuries for some 5,000 more. Now, Mr. Speaker, the question may be asked: is it necessary to make seat belt use mandatory to save those 50 to 100 lives? I believe the answer has to be, yes, it is necessary. Seat belts have been promoted as a safety device in Saskatchewan cars since 1952. Belts have been installed in every new car sold in Canada since 1964. Many millions of dollars have been spent on advertising, public relations, safety education. This expenditure of money both public and private has produced a highly favourable attitude in the public mind toward seat belts, but in the one area where it counts, the percentage of people who actually buckle up, the effect of all these efforts has been very, very slight.

In Saskatchewan, today, less than 15 per cent of people use their seat belts regularly. By contrast, in Ontario, where the seat belt law has been in effect for 14 months, the most recent survey of use showed that upwards of 60 per cent wear seat belts regularly.

It is the considered opinion of medical experts, safety organizations and research institutions, all of which are close to the situation and knowledgeable about real life conditions, as they affect traffic safety, that only the mandatory requirement of seat belts will effectively raise and maintain the use of these lifesaving devices.

Some people, Mr. Speaker, argue that requiring people to buckle up infringes on their personal liberty, and to some extent it does. The real issue is not whether seat belt use infringes on liberty, but whether the law can be justified by weighing the gains against the losses in terms of the public interest.

The principle of this legislation is not new. People who use other modes of travel must follow rules based on the personal and public safety principles. People who fly in aircraft must submit themselves to a personal search. They must also allow their luggage and their possessions to be searched. Once aboard the aircraft they must buckle up. People who drive motorcycles must buy helmets and wear them at all times on the motorcycle. People who go out on the lake in their boats must carry lifejackets. People may also be asked to submit themselves to inoculation to ward off disease. In each case the same principle is as in this Bill and has been widely accepted. No Opposition politician has ever called for a plebiscite on inoculation or on aircraft safety rules, yet when the same principle is applied in the same way to seat belts the Opposition grasp at any straw to try to capitalize on fears of anything new.

Every individual, Mr. Speaker, should be able to expect his fellowman to help him out in times of adversity. By the same token the individual has an obligation not to impose unnecessary burdens on his fellowman. Traffic injuries and deaths are a very large burden and in many cases an unnecessary burden. When an individual is hurt or killed in an accident, he involves not only himself, but he involves his

family and his friends, his employer and society at large. The total economic loss due to traffic accidents each year is in the order of $75 million. Among people under 30, motor vehicles are the leading cause of death.

Saskatchewan has one of the highest rates of death of any province. The average for Canada in 1974 was 27.9 deaths for every 100,000 population and in this province 33.7 people per 100,000 died last year. Over 20,000 days of hospital care are devoted to victims of traffic accidents every year. Approximately 20 persons are paralysed each year in accidents, a tragic consequence for the individual and an expensive consequence for everyone else with the cost of care estimated at about one quarter of a million dollars over a lifetime.

Many millions of dollars are paid out each year in insurance settlements, medical costs, hospital care, various forms of compensation and welfare expenses. A substantial part of this outlay, not to mention the human grief and misery it represents, could be avoided. Seat belt use is the single most effective means of reducing the burden imposed by traffic accidents. Those who speak of freedom must remember that for every privilege in a democracy there is a corresponding responsibility.

I want to read, to this Assembly, from a letter sent to Premier Blakeney by a doctor who was upset that seat belt legislation might not proceed at this Session. The letter states:

> . . . the personal freedom to drive without seat belts may be compared with the freedom to drive on the left side of the road. It is a minor freedom that must be traded off for the freedom to drive a two-ton vehicle at 60 miles per hour. I am personally all too familiar with the results of road traffic accidents many of which would be prevented or lessened by the use of seat belts. You are welcome to be the guest of my department at the performance of any autopsy on a victim of a road traffic accident. I am sure my clinical colleagues would be glad to afford you the more tragic experience of participating in the care of people, usually young people paralysed or maimed in such accidents.
>
> To reduce such tragedies we can afford to lose a little illusionary personal freedom. If your Government is unwilling to introduce compulsory seat belt legislation there is, of course, another out open to it. This is to render void all insurance apart from third party insurance, automobile, hospital and medical care insurance of those who choose to drive without seat belts. Such legislation is already in effect for those who choose to drive while drunk. It would be of interest to see if a government, which apparently places such regard on personal freedom is equally willing to assign personal responsibility for the results of such freedom.

That letter, Mr. Speaker, is signed by H. E. Emson, MD, head of Pathology, University Hospital, Saskatoon. I should like to table that letter right now.

Mr. Speaker, the writer states his case very effectively. Those who choose to posture on behalf of freedom may also be prepared to explain their commitment to personal responsibility.

Other arguments have been used to oppose seat belt legislation. It is claimed that being strapped in could be detrimental in a fire or in water. The facts show that fewer than one-half of one per cent of all accidents involve fire. In any event it is useless to talk about leaving a burning or submerged car if the driver is unconscious because he has been thrown around inside it. The best bet anyone has to remain conscious and be capable of escape is to wear a seat belt. Those who claim that it is better to be thrown free are not supported by the facts. The vast majority of those who are thrown out of their car are seriously injured and many are killed. In any accident the best protection is the car around you and the only way to be sure of it is to use seat belts.

It is abundantly clear, from the accumulated evidence from many sources, that seat belts are highly effective and by far the best alternative for preventing deaths and injuries.

This Bill will make their use mandatory in the front seats of all cars, which are factory equipped with them. An exemption is provided for children under five, or 50 pounds, and for persons who obtain a medical certificate to that effect. The clauses stating seat belt use will be proclaimed effective July 1, 1977 but enforcement will be set forward three months until October 1st and warnings will be issued in the three month interval. Mr. Speaker, seat belts are the keystone of the Safety '77 Program, which consists of at least six other major components all aimed at making it safer to drive in Saskatchewan.

. . .

MR. COLLIVER:

Finally, Mr. Speaker, with reference to the compulsory seat belt legislation, we can accept certainly that the statistical evidence everywhere indicates that an increased utilization of seat belts has, without any question of any doubt, been proven by the safety experts to reduce injury and to reduce the chances of death. It would seem to suggest that compulsory seat belt legislation is an assist. However, if the Minister examines his own statistics, he will note in the Province of Ontario, 14 months after the introduction of the compulsory seat belt legislation by the government, without any support of the people of the Province of Ontario prior to its introduction and without really any phenomenal campaign as would result in educating the population prior to a plebiscite, for example, on the use of seat belts, you

will note that 40 per cent of the drivers in Ontario are breaking the law. In his own statistics today, 40 per cent are breaking the law. Now it may be that the 60 per cent who are now using seat belts in Ontario, compared to the 15 per cent in the Province of Saskatchewan certainly is a saving. But have the people of Ontario been convinced of the benefits of seat belt legislation, of compulsory seat belts? In my judgment certainly 40 per cent have not because they are breaking the law. Does this not call into question, when you have a law in which 40 per cent of the people are breaking the law on a regular basis, does this not call into question the standards of all of the laws of the Province of Ontario?

We are very concerned in the Province of Saskatchewan that the people of Saskatchewan, and most especially the people of Saskatchewan in the rural communities, have not had an opportunity to first, see all of the benefits in advance of the legislation; secondly, to be shown by the various organizations that are involved in traffic safety the benefits to be derived from compulsory legislation.

We furthermore think that it is the kind of an issue which, unlike the decision to get into someone else's plane and fly in someone else's plane where you are required to buckle up, is getting into your own personal vehicle and making a decision to buckle your seat belt. This kind of legislation should be offered to the people of the Province of Saskatchewan for their assessment, for their opinion, for their decision directly.

It's very similar to the fluoridation of water supply. The fluoridation of water supplies was, by the Government of Saskatchewan, offered to individual communities to make a decision on the basis of the decision of the local community by means of a plebiscite. Surely the people of Saskatchewan, in this kind of legislation, should have an equal opportunity to express their opinion and in fact to have the period of time in which there is a concerted drive, not only by the Government of Saskatchewan but by all traffic organizations, to convince them prior to the legislation of the necessity for this kind of legislation. We believe very strongly that because of the divergence of opinion in the Province of Saskatchewan with reference to compulsory seat belt legislation, not the benefits of seat belts, because I think almost everyone is prepared to accept the benefits of using a seat belt, but the compulsory aspect of this legislation does cause us some concern without a direct indication from the people that it is their desire to have such legislation on the books in Saskatchewan.

Mr. Speaker, I have a great deal more to say on this subject and I beg leave to adjourn debate.

Debate adjourned.

. . .

MR. D. M. HAM: (Swift Current) I'd like to address a few remarks if I may.

Mr. Speaker, I might qualify my remarks by saying I personally wear, my wife and my two children wear seat belts. I have a seven year old son and a five year old daughter. I have pledged in public and in private that I will spend whatever time is necessary to convince those who don't believe in the use of seat belts that they should wear them.

However, Mr. Speaker, I should relate at this time a conversation that took place between myself and a Member of the Government last May when this House prorogued. It revolved around a subject of seat belts, wherein I was criticized that I was taking an Opposition stand to the use of mandatory seat belts. References to the medical costs as are being advertised regularly on television . . . Mr. Speaker, if the Attorney General would listen to hear what I have to say . . .

MR. SPEAKER: Order! Order! I notice the Attorney General hasn't spoken on this Bill and I'm sure he'll get an opportunity. Member for Swift Current.

MR. HAM: I'll start again, Mr. Speaker. This was a very friendly conversation, for the sake of the Attorney General, and I have no intentions of causing any problems for anyone in this House, let alone me.

In any event, the discussion and the argument if you like, revolved around the use of seat belts and the fact that I was speaking against the mandatory use of seat belts and he took the opposite stand. He felt and probably had just reason to feel that it was costing our society millions upon millions of dollars to maintain and treat the people who were injured as a result of car accidents and the lack of using a seat belt.

I found it somewhat ironic, Mr. Speaker, that this Government can find $272 million to buy potash mines, but when it's an expense that concerns those who are injured, then there is a concern.

After some very explicit statements, I stopped the Member and suggested that, I summarized what he was saying and I think probably in these discussions, that he felt it was our responsibility as elected Members to protect the public from themselves. I suggest to him and I suggest to this House that maybe a comparison is in order, in that it has been suggested by so-called medical experts in our society that one smoking in a confined area, such as a car, is causing as much harm to those around him as he is to himself. In other words he is a hazard. I went on to suggest, Mr. Speaker, that a man not wearing a seat belt was only a hazard to himself, where a man smoking in a car is a hazard to those around him. My concern, Mr. Speaker, is where does legislation

like this stop and start. I asked this Member, what would he do in the circumstances of a man smoking, if a man is causing harm to his fellows, do you legislate 'no smoking' in society? What disturbed, Mr. Speaker, and what disturbs me in many instances of similar legislation, are the words that followed, "You do these things one step at a time." What's next and where do we stop?

I think it's in order, Mr. Speaker, at this time to read into the records an editorial from the Criminal Law Quarterly of March, 1976, to further my concerns.

> It is, of course, easy to legislate and with the best will in the world our legislators do not always enact good legislation. One can take as an assumption that car fatalities and serious injuries are so common-place as to present some grave social economic problems and that the use of seat belts reduces considerably the fatal or serious nature of many automobile accidents. On those assumptions, one must conclude that only the foolish would not wear seat belts when driving. I'm not sure that this is all that can be said either for or against the fact of wearing seat belts, but I'm prepared to accept those assumptions.
>
> Therefore, or so the argument runs, the Ontario Government has done the proper and sensible thing in making it an offense, subject to a few exceptions, not to wear seat belts when driving. Even though, so the Premier is reported to have said, the law would be difficult to enforce and is mainly there as an educative technique. It is a pity that some echo of the Hart Devlin debate does not seem to have penetrated Queen's Park. One cannot legislate sense into being, or stupidity out of existence. Even if one could, the criminal law is not the right technique. We have perhaps learned that one cannot legislate morality into being, or immorality out of existence. For the most part we accept that one's morality exists side by side, but independence of the law for morality, whether learned or innate is individual but not imposed.
>
> A law that is ignored is bad, not for the law, but for the legal system. A law that cannot be enforced brings into disrepute not only the law, but the whole process of law. A law that achieves little or nothing but irritates and annoys the citizens, creates a further gap between him and all of those charged with the enforcement of all laws, not just that one.
>
> The creation of most criminals cannot be the objective of the law. We must learn that the objective of the law is the ordered running of what most of us conceive of as society as freely, economically beneficially and if this is not too hackneyed, happily as possible.

> However, the welfare state has another dimension. The argument is now advanced that the injured driver is a costly burden on the taxpayer as is the injured passenger. The death of a breadwinner may mean the burden of supporting his family shifts from him to us. We have a direct economic interest in seeing that he stays healthy and alive. Let us therefore impose a criminal sanction on anyone who increases the risk of that economic burden.
>
> But to the Wolfenden philosophy one now adds as justification for criminal law the economic burden may result in being imposed on the rest of us from an act or omission. One can appreciate the superficial attractiveness of such justification but one must also recognize its dangers.

For the Member for Thunder Creek's information, I said earlier, this is from the Criminal Law Quarterly. I am just about finished.

> What of an alcoholic - a costly member of society. What of a cigarette smoker whom we may have to keep, to say nothing of the marijuana smoker or the barbiturate addict. What of the neurotic psychotic. What indeed of the sick and the elderly. Do we suggest that prohibition of alcohol, the banning of tobacco, is ill health or sickness to be an offense?
>
> Economic burden as a justification for criminal law must lead to determination of fault and responsibility, for it means distinguishing the stupid and selfish from the sensible but unfortunate. I am not sure that that is all that much different from trying to distinguish the moral from the immoral. To use these criteria as distinguishing factors in a sentencing process, as has been done for years, is one thing, but to use them as a basis for criminal law is frightening. It may be true that the welfare state will necessitate a re-thinking of nature and the purpose of criminal law. If it does, a minor amendment to the Highway Traffic Act does not seem to be the place to start.

Mr. Speaker, this presentation and the presentation of this legislation is no doubt contentious. I am sure we all realize the political ramifications, at least on a temporary basis. I am not concerned about the political ramifications. Philosophically I oppose and because of these feelings, strongly support placing this issue before the people of Saskatchewan in the form of a plebiscite. The wearing of seat belts should be an individual decision. We should not be forcing our citizens. It is unfortunate that other worthwhile proposals in this Bill cannot be separated or have to be considered as part of the total package. We agree with these other proposals.

Without a concerted campaign in Ontario by the Highway Traffic Council, 40 per cent of the citizens are breaking the law. The recent Safety '77 campaign instigated by the Government and the Saskatchewan

Safety Council is commendable and should be continued. We need a concentrated effort for six months to allow all Saskatchewan citizens to analyse and understand the advantages of seat belts, followed by a provincial plebiscite.

No doubt all Members have had either letters or personal visits by opponents of this legislation. We have seen and continue to see mass letters to editors in local papers in opposition to these proposals of compulsion.

Mr. Speaker, I therefore move, seconded by the Member for Rosetown-Elrose (Mr. Bailey) that all words after the word 'that' be deleted and that the following be substituted therefor:

> Bill No. 104 be not now read a second time, but that it be read six months hence.

MR. SPEAKER: Order, order! I find the Motion in order and debate continues concurrently on the Motion and the amendment.

MR. E. C. MALONE: (Leader of the Opposition) Mr. Speaker, I should like to say a few words about this Bill before 5:00 o'clock.

It is very interesting to notice the positions of the Tories and I say positions advisedly, Mr. Speaker. Their leader rose in this House the other day and said that he was in favor of seat belts, but maybe he wasn't in favor of seat belts. He said that there should be a referendum called on the particular issue. Well, Mr. Speaker, I think that referendums are viewed by most politicians with suspicion. I think that they are really the politician's cop-out. Those who haven't got the guts to make up their own minds as to the goodness or badness of a particular law, always go out and take the easy way out and say, "Well, let's have a referendum about it."

I suggest, Mr. Speaker, that this is not a moral issue where we take referendums. It's not an issue that we can't deal with adequately in this House by making up our own minds and suffering the consequences if we should decide in a manner that the voters do not particularly approve of.

I don't think, Mr. Speaker, that we are elected to sit in this House to always run to the public for a referendum as soon as a politically contentious issue arises. The Government has decided in its wisdom that they are going to put in legislation in favor of compulsory seat belts to be worn by operators of motor vehicles.

We in the Liberal caucus have decided to not be in favor of that legislation, to oppose it. We reached these decisions, I submit, Mr. Speaker, after some consideration, after some deliberation and really some hardship in our caucuses as to the position that we are going to take. But nevertheless, we've reached a position, we've made a decision. We in the Liberal caucus oppose such legislation and I'll be getting to the reason for that opposition in a moment or so.

But I think it ill behoves people to come to this Legislature and say, "Well, some parts we like; some parts we don't like; well it's really a tricky matter, I guess we'll have to go back to the people to decide what we should really do." The people elected the Members of this Legislature to make those decisions and not to continually run back with referendums or plebiscites or whatever. I suspect that the next Conservative speaker we are going to hear is going to jump up and say, "Well, I support seat belts." So that they can go around this province in the days ahead and in one area say, "Well we supported it," and in the other area say, "we're opposed to it," and in another area say, "we didn't make up our mind, we wanted a plebiscite or a referendum on it."

I think the people of Saskatchewan will realize pretty quickly, Mr. Speaker, that on this issue, like most issues that have come before this Legislature, the Tories really have no position at all.

Before getting into the seat belt aspect of the legislation, Mr. Speaker, I would like to talk about some of the other things that this particular Bill does by way of amendments. Most of the contents of the Bill, we agree with, the provisions from Section 4 on to the seat belt legislation. I don't think anybody on this particular side of the Legislature would disagree with and I say to the Government that we would support your endeavors in this regard.

. . .

MR. MALONE:

Getting back to the seat belt legislation itself, Mr. Speaker, we oppose this compulsory aspect of the legislation. But I want to make it very clear that we do not oppose the use of seat belts. Indeed I think the arguments used by the proponents of seat belts are very compelling indeed and that statistics would indicate that where people use seat belts, the injuries that are incurred in automobile accidents are reduced substantially. There are some examples, Mr. Speaker, of course as to where the use of seat belts has actually occasioned injury or resulted in more serious injury. But I think on balance, the statistics would indicate that in the majority of cases that those who use seat belts are protected thereby and that injuries do not result therefrom.

But we oppose this legislation, Mr. Speaker, for basically three reasons. We acknowledge that those who are in favor of such legislation have very many compelling arguments, very many arguments that are

persuasive indeed. But we believe that the three reasons I am about to give are more compelling than those arguments in favor of seat belts.

Firstly, Mr. Speaker, let me say this. We in the Liberal caucus, believe that by far the majority of the people of Saskatchewan are against the use of seat belts, particularly in rural areas. We the Liberal caucus, believe as well, that the wishes of the majority of voters, the majority of this province, should be respected and that no government should pass laws against the wishes of the majority unless there is a very compelling reason indeed.

Now the first question, of course, Members opposite will say is, "Why do you say the majority is opposed?" Well I suppose, Mr. Speaker, it's the way any politician reads the people that he represents, reads the feeling of the public. In my office I know that I have received many representations both pro and con compulsory seat belts. But let me say that the representations against compulsory seat belts far, far outweigh in number the representations for compulsory seat belts. Indeed if my mail and phone calls and other representations are any indication, I would think that the majority of the proportion of people against this type of legislation would be five or six to one. Recently I have had an opportunity of speaking in several rural areas in Saskatchewan and I have posed to the people at those meetings - outside of Pelly as well - indeed many meetings in Pelly and indeed a very successful meeting last Saturday night - well over 600 people ignored the threat of a bomb being planted in our hall either by the Tories or by the NDP and moved on to another hall where the ranks of the crowd swelled even more, Mr. Speaker, - I'm slipping from the point I am talking about, Mr. Speaker.

But indeed the people of Pelly and the people of several other constituencies that I have had the pleasure of going to in recent weeks have indicated to me that they are very much opposed to this compulsory legislation. All the people indicate that seat belts are good. All the people indicate that from time to time they use seat belts, but all the people as well believe that that's a personal choice for them and not for government to legislate.

As I indicated, Mr. Speaker, I believe that government, of whatever party, should respond to the wishes of the majority in the legislation that they represent.

Now, this moves me to the second reason, Mr. Speaker. Members opposite will say, "Well, from time to time government must pass legislation that will help people, legislation that people may not like but will be for their own good if it is passed." They point to other legislation that we have on the books of the province and on the books of the Dominion. But to answer that argument, Mr. Speaker, let me say this. The Liberal Party believes that before you pass legislation that interferes with anybody's personal conduct, personal activities, in-

deed personal freedoms, there must be very, very clear proof indeed that such legislation is going to protect the overall public good, the overall public welfare. Many of the pieces of restrictive legislation that we have on the law books now, people acknowledge, is for the public welfare. Members opposite use the example of somebody driving an automobile at 100 miles an hour down a highway and they say nobody objects to that type of legislation. And indeed they don't, because if people drove an automobile at 100 miles an hour down a highway, they would be very much endangering the other users of that highway. And there are other examples that they give. But I point out, Mr. Speaker, that those who choose not to wear seat belts are endangering only themselves. They are not causing a hazard to anybody else in society as a result of their decision. And if they should be risky enough to make such a decision, they are not endangering me or my colleagues or my family or my constituents by making that decision in their own mind. The only person that they endanger is the person who makes that decision as I have indicated.

I suggest to you, Mr. Speaker, that governments should not be making that decision for those people. Those people have the right in their own mind if they feel that strongly about it, not to wear seat belts if they so choose. And I emphasize the only person they endanger because they decide that way is themselves.

Now the next argument advocated by the proponents of compulsory seat belt legislation is that what I say is wrong, that because I choose not to wear a seat belt and if I get into an accident and I get injured, I therefore cause a charge on the public purse, because indeed the public purse must pay for the medical care that I require to be repaired, the hospitalization that is necessary and indeed in some cases, the person's family becomes a charge on the social welfare system. And indeed that is an interesting and compelling argument as well. But once again, Mr. Speaker, we must ask ourselves how far the Government should go in legislating personal conduct, personal morality, personal behavior.

For those who advocate that proposal, that argument, let me put this to them as well. I believe that far more public funds are spent in the Province of Saskatchewan because of the misuse of alcohol, because of alcoholism, because of people becoming involved in automobile accidents while driving while impaired, because of the risk to your health by overuse of alcohol, and so on. I would suspect that the cost to the taxpayers of Saskatchewan is probably in the millions and millions of dollars because a very few of the people of Saskatchewan, a very small minority, abuse their right to indulge in alcoholic spirits if they so choose. I suspect the cost is astronomical when we consider it in human terms as well as in dollar terms. But nobody suggests that there should be legislation passed to prevent the use of alcohol, because indeed the experience we have had in this continent when such legislation was enforced, was to show that people simply ignored the law and they went on and they continued to drink and even greater difficulties arose because it was an illegal procedure.

But we've learned from that experience that government can't legislate that type of personal morality notwithstanding the arguments that they use that it is for the overall good. Another argument that could be used is tobacco, the use of cigarettes, cigars, which I over-indulge in, pipe tobacco, and so on. Once again, people who choose to use tobacco in their own way are putting a charge on the public purse in many cases because their over-use causes such things as lung cancer, heart disease and related medical problems. And once again we don't have the Government opposite, or any government anywhere, using that particular excuse as a device to legislate against the use of tobacco. Once again it's a matter of governing personal conduct, personal behavior and no government in its right mind, of course, would pass laws that would govern people's personal behavior in this way.

Indeed they pass laws to make the use of alcohol and perhaps the use of tobacco somewhat difficult because of the high taxes they put on those two products, but once again no laws to ban their use because people want to use those two particular things.

Taking it even a step further, as I suppose that if we followed the advice of the Minister of Health, which is good advice and exercised regularly and watched a proper diet, once again we would cut the cost to the public purse of moneys spent to pay for the medical costs of those who don't diet properly or don't exercise properly. But we haven't yet, I hope, reached the stage where we are going to legislate personal habits in this way.

We in the Liberal Party, Mr. Speaker, have decided that you have to draw the line somewhere as to where the Government must stop legislating personal behavior. We have chosen to draw the line on seat belts because we believe that the Government cannot legislate that type of law because people simply will not obey that law.

Which brings me to the third reason, Mr. Speaker, for our opposition to this provision of The Vehicles Act. We believe the law is simply unenforceable. It is unenforceable because people don't want the law. It is unenforceable because of the physical routines that law enforcement agencies would have to go through to make the law enforceable. They would have to stop every motor vehicle in every town, in every city and every country road to check to see if people were wearing their seat belts. Nobody of course envisages that happening. Nobody of course wants that to happen. But nevertheless it makes the law unenforceable. And there is an old rule, Mr. Speaker, that all legislatures and all lawyers are aware of, is that if you can't enforce a law, you don't pass that law, because if you do so, it puts that particular law into contempt, and if one law is held in contempt, it is a short period of time, Mr. Speaker, before other laws start being held in contempt. That in itself is reason enough, as far as I am concerned, to oppose this type of legislation.

So, Mr. Speaker, let me sum up by saying there are three reasons why we oppose the legislation. Number one, the people of Saskatchewan, the majority of the people of Saskatchewan, don't want the legislation. It may well be in months to come or years to come that an educational program would put the people of Saskatchewan in such a position where there was a demand for such legislation, but that's not the point at this point in time, Mr. Speaker.

Secondly, we feel that government cannot legislate personal conduct, personal habits and personal freedoms. That's what this law is trying to do.

Thirdly, Mr. Speaker, the law is unenforceable and will be held in contempt by all people of this province if the law is passed.

We feel those three reasons are compelling reasons. They are reasons enough for this legislation not to be passed.

Now, Mr. Speaker, I have been asked by one of the other Members who cannot be here tonight to adjourn debate on his behalf as he wants to speak about the matter and accordingly, Mr. Speaker, at this time, I ask for leave to adjourn debate.

Debate adjourned.

. . .

TUESDAY, May 10, 1977

The following Bills were reported with amendment, considered as amended, and by leave of the Assembly, read the third time and passed:

Bill No. 105--An Act respecting the Superannuation of Certain Persons under Certain Superannuations Acts.

Bill No. 104--An Act to amend The Vehicles Act (No. 2).

OBJECTIVE: Explain the pros and cons of passing laws to alter social practices that have been proven to be scientifically inadvisable.

ANNUAL REPORT 1978-1979*

Department of Highways and Transportation

[*Annual Report 1978-1979, (Department of Highways and Transportation, Motor Vehicle Branch, Winnipeg). Reprinted with permission.]

MOTOR VEHICLE TRAFFIC ACCIDENTS
1978
BY NATURE OF ACCIDENT AND
ROAD LOCATION
RURAL

ROAD LOCATION	YEAR	NATURE OF ACCIDENT: FATAL	NON-FATAL	PROP. DAMAGE	TOTAL	PERCENT IN EACH CATEGORY
INTERSECTION TRAFFIC LIGHT	78	2	24	22	48	.7
	77	-	35	34	69	.9
	% CHANGE 77 - 78	+ 00	- 31.4	- 35.3	- 30.4	
INTERSECTION STOP SIGN, FLASHING LIGHT	78	5	97	260	362	5.1
	77	2	138	253	393	5.0
	% CHANGE 77 - 78	+150.0	- 29.7	+ 2.8	- 7.9	
INTERSECTION OTHER CONTROL	78	2	53	142	197	2.8
	77	3	61	131	195	2.5
	% CHANGE 77 - 78	- 33.3	- 13.1	+ 8.4	+ 1.0	
INTERSECTION NO CONTROL	78	8	120	281	409	5.8
	77	7	142	341	490	6.2
	% CHANGE 77 - 78	+ 14.3	- 15.5	- 17.6	- 16.5	
INTERSECTION PRIVATE DRIVEWAY, STREET	78	1	25	172	198	2.8
	77	1	42	190	233	2.9
	% CHANGE 77 - 78	-	- 40.5	- 9.5	- 15.0	
STRAIGHT ROAD	78	67	1,025	3,109	4,201	59.1
	77	59	1,034	3,602	4,695	59.1
	% CHANGE 77 - 78	+ 13.6	- .9	- 13.7	- 10.5	
CURVE	78	17	315	819	1,151	16.1
	77	15	339	847	1,201	15.2
	% CHANGE 77 - 78	+ 13.3	- 7.1	- 3.3	- 4.2	
HILL	78	1	9	31	41	.6
	77	-	7	25	32	.4
	% CHANGE 77 - 78	+ 00	+ 28.6	+ 24.0	+ 28.1	
RAIL CROSSING WITH CONTROL	78	-	1	3	4	.1
	77	-	-	1	1	...
	% CHANGE 77 - 78	-	+ 00	+200.0	+300.0	
RAIL CROSSING NO CONTROL	78	3	5	24	32	.5
	77	3	2	9	14	.2
	% CHANGE 77 - 78	-	+150.0	+166.7	+128.6	
LOCATION NOT STATED	78	2	68	386	456	6.4
	77	3	82	518	603	7.6
	% CHANGE 77 - 78	- 33.3	- 17.1	- 25.5	- 24.4	
ALL LOCATIONS	78	108	1,742	5,249	7,099	100.0
	77	93	1,882	5,951	7,926	100.0
	% CHANGE 77 - 78	+ 16.1	- 7.4	- 11.8	- 10.4	

MOTOR VEHICLE TRAFFIC ACCIDENTS
1978
BY NATURE OF ACCIDENT AND
ROAD LOCATION
PROVINCIAL TOTAL

ROAD LOCATION	YEAR	NATURE OF ACCIDENT FATAL	NON-FATAL	PROP. DAMAGE	TOTAL	PERCENT IN EACH CATEGORY
INTERSECTION	78	9	1,257	3,307	4,573	11.7
TRAFFIC LIGHT	77	9	1,179	3,315	4,503	11.0
% CHANGE 77 - 78		-	+ 6.6	- .2	+ 1.6	
INTERSECTION	78	13	1,055	3,737	4,805	12.3
STOP SIGN, FLASHING LIGHT	77	7	1,017	3,488	4,512	11.0
% CHANGE 77 - 78		+ 85.7	+ 3.7	+ 7.1	+ 6.5	
INTERSECTION	78	5	465	1,717	2,187	5.6
OTHER CONTROL	77	7	424	1,779	2,210	5.4
% CHANGE 77 - 78		- 28.6	+ 9.7	- 3.5	- 1.0	
INTERSECTION	78	16	652	2,077	2,745	7.0
NO CONTROL	77	10	588	2,197	2,795	6.8
% CHANGE 77 - 78		+ 60.0	+ 10.9	- 5.5	- 1.8	
INTERSECTION	78	1	163	1,519	1,683	4.3
PRIVATE DRIVEWAY, STREET	77	1	195	1,786	1,982	4.8
% CHANGE 77 - 78		-	- 16.4	- 14.9	- 15.1	
STRAIGHT ROAD	78	92	3,233	12,179	15,504	39.7
	77	81	2,990	13,005	16,076	39.4
% CHANGE 77 - 78		+ 13.6	+ 8.1	- 6.4	- 3.6	
CURVE	78	21	600	1,920	2,541	6.5
	77	18	623	1,979	2,620	6.4
% CHANGE 77 - 78		+ 16.7	- 3.7	- 3.0	- 3.0	
HILL	78	1	20	129	150	.4
	77	-	12	90	102	.2
% CHANGE 77 - 78		+ 00	+ 66.7	+ 43.3	+ 47.1	
RAIL CROSSING	78	-	3	7	10	. . .
WITH CONTROL	77	-	2	2	4	. . .
% CHANGE 77 - 78		-	+ 50.0	+ 250.0	+ 150.0	
RAIL CROSSING	78	3	17	44	64	.2
NO CONTROL	77	3	16	28	47	.1
% CHANGE 77 - 78		-	+ 6.3	+ 57.1	+ 36.2	
LOCATION NOT STATED	78	5	554	4,259	4,818	12.3
	77	4	649	5,393	6,046	14.9
% CHANGE 77 - 78		+ 25.0	- 14.6	- 21.0	- 20.3	
ALL LOCATIONS	78	166	8,019	30,895	39,080	100.0
	77	140	7,695	33,062	40,897	100.0
% CHANGE 77 - 78		+ 18.6	+ 4.2	- 6.6	- 4.4	

MOTOR VEHICLE TRAFFIC ACCIDENTS
1978
BY NATURE OF ACCIDENT AND
TYPE OF ROAD

TYPE OF ROAD	YEAR	NATURE OF ACCIDENT: FATAL	NON-FATAL	PROPERTY DAMAGE	TOTAL	PERCENT IN EACH CATEGORY
PAVED	78	116	6,824	25,557	32,497	83.1
	77	106	6,316	24,977	31,399	76.9
	% CHANGE 77 - 78	+ 9.4	+ 8.0	+ 2.3	+ 3.5	
GRAVEL	78	29	508	2,509	3,046	7.8
	77	19	526	2,368	2,913	7.1
	% CHANGE 77 - 78	+ 52.6	- 3.4	+ 6.0	+ 4.6	
LOOSE GRAVEL	78	11	235	558	804	2.1
	77	6	230	600	836	2.0
	% CHANGE 77 - 78	+ 83.3	+ 2.2	- 7.0	- 3.8	
DIRT	78	5	43	229	277	.7
	77	5	60	232	297	.7
	% CHANGE 77 - 78	-	- 28.3	- 1.3	- 6.7	
TYPE NOT STATED	78	5	409	2,042	2,456	6.3
	77	4	563	4,885	5,452	13.3
	% CHANGE 77 - 78	+ 25.0	- 27.4	- 58.2	- 55.0	
ALL TYPES	78	166	8,019	30,895	39,080	100.0
	77	140	7,695	33,062	40,897	100.0
	% CHANGE 77 - 78	+ 18.6	+ 4.2	- 6.6	- 4.4	

* MOST ACCIDENTS OCCUR ON PAVED ROADS BECAUSE OF GREATER TRAFFIC VOLUMES ON PAVED ROADS PLUS THE FACT THAT THE MAJORITY OF THE ROADWAY IN THE PROVINCE IS PAVED. OF THE APPROXIMATELY 2,085 MILES OF ROADWAY IN THE CITY OF WINNIPEG AS OF DEC. 31, 1978-84% WERE PAVED, 12% WERE GRAVEL AND 4% WERE EARTH OR OTHER SURFACE. OF THE APPROXIMATELY 11,675 MILES OF PROVINCIAL TRUNK HIGHWAYS AND PROVINCIAL ROADS MAINTAINED BY THE PROVINCIAL DEPARTMENT OF HIGHWAYS AS OF JAN. 1, 1978-49% WERE PAVED AND 51% WERE GRAVEL. HOWEVER, IT IS IMPORTANT TO NOTE THAT THE HIGH TRAFFIC DENSITY PROVINCIAL TRUNK HIGHWAYS (APPROX. 4,000 MILES IN TOTAL) ARE VIRTUALLY ALL PAVED.